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SUPREME COURT OF THE UNITED STATES.

ORIGINAL ACTION NO. 27.

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THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA,

Defendant.

ON MOTION TO OPEN, PRINT AND FILE RECORD AND FOR DIVISION OF COST OF PRINTING.

BRIEF OF STATE OF MINNESOTA IN OPPOSITION TO MOTION.

CLIFFORD L. HILTON,
Attorney General,
JOHN E. PALMER,
Assistant Attorney General,
Solicitors for Defendant.

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ON MOTION TO OPEN, PRINT AND FILE RECORD AND FOR DIVISION OF COST OF PRINTING.

BRIEF OF STATE OF MINNESOTA IN OPPOSITION TO MOTION.

A cursory examination of the record will disclose that complainant's bill is without equity, and this for reasons assigned at the outset of the hearing before the commissioner, and here respectfully urged upon the consideration of the court in opposition to the pending motion. We quote from the record:

"The attorneys for complainant announced that they are ready to proceed and John E. Palmer (of counsel for

defendant) announced that he wished to make certain objections and motions in behalf of the defendant before any testimony was taken on the part of the complainant. There being no objection, the following objections and motions were made, to-wit:

The state of Minnesota objects to the receiving of any evidence under the bill of complaint herein for the reasons:

1. That it appears on the face of said bill of complaint that the matters set forth therein do not constitute a controversy between the state of North Dakota and the state of Minnesota justifiable in this court under the constitution.

2. That it appears on the face of said bill of complaint that no property rights of the state of North Dakota are affected by the matters alleged; and that the controversy, if any exists, is between private land owners and the state of Minnesota, and that the state of North Dakota is in fact only lending its name to these individuals for the redress of alleged private wrongs and injuries.

3. That it appears on the face of said bill of complaint that the drainage of water through the Mustinka state ditch to the territory of North Dakota alleged to have been injured and being injured is only such water as naturally is cast upon said territory.

4. That it appears upon the face of said bill of complaint that if the Mustinka state ditch operates at all to the damage of the territory in North Dakota alleged to be injured, it so operates only in times of flood; and such injury, if any, is damnum absque injuria under the doctrine of Jackson v. United States, 230 U. S. 1, and Cubbins v. Mississippi River Commission, 241 U. S. 351.

5. That the bill of complaint is multifarious in that it seeks both equitable relief by way of injunction and legal relief by way of a judgment for damages.

The state of Minnesota further moves that the complainant be compelled to elect whether it will proceed in an equitable suit for an injunction or an action at law for the recovery of damages; and if it elects the latter the state of Minnesota objects to any proof thereunder as not within the original jurisdiction of this court.

The state of Minnesota further moves that this cause be dismissed for want of equity appearing upon the face of the bill of complaint."

In addition to the authorities cited in the fourth objection, defendant urges that the act of the legislature of Minnesota set forth at pages 14 to 17, inclusive, of the bill of complaint shows upon its face that the construction of an outlet to the Mustinka state ditch was committed to the discretion of the state drainage commission, no specifications or directions as to the method of its construction, its size, capacity or even its location being designated in the act of the legislature. See Chapter 138, Laws of Minnesota 1911. The earlier statutes under which the first portions of this ditch were constructed in 1894 and 1896, are even more general in terms. See Chapter 221, Laws of Minnesota 1893, and Chapter 164, Laws of Minnesota 1895. These statutes merely designate the counties in which the drainage commission shall construct ditches for the drainage of state swamp lands. It is submitted that if these ditches were constructed in such manner as to injure lands in the state of North Dakota, the state of Minnesota as such is not responsible therefor; and the controversy is not one between the state of North Dakota and the state of Minnesota. In support of this proposition the defendant relies upon Louisiana v. Texas, 176 U. S. 1; Railway Co. v. Missouri Commissioners, 183 U. S. 53, and kindred cases.

Defendant further submits that the three legislative acts under which all of the acts of the state drainage commission of Minnesota were done, clearly and conclusively show that the drainage project complained of was constructed solely for the purpose of draining state swamp lands granted to the state of Minnesota for drainage and reclamation. No argument or citation of authority is required in support of the proposition that the state of Minnesota cannot be penalized for carrying out the obligation laid upon it by congress in the grant of these

swamp lands under the act of September 28, 1850, as extended to the state of Minnesota by the Act of March 12, 1860.

It is stated in the complainant's brief upon this motion that the action is brought for the diversion of large quantities of water from its natural destination. On the contrary, the bill of complaint clearly shows that all of the drainage complained of has its natural outlet into Lake Traverse and the Bois de Sioux river.

In behalf of the second objection it is urged that the bill of complaint clearly shows that the action is brought by the state of North Dakota to recover damages for private land-owners in violation of the Eleventh Amendment of the Federal Constitution, and upon this point we cite New Hampshire v. Louisiana, 108 U. S. 76. This objection is taken by the answer as well as upon the hearing.

Defendant specifically objects to the granting of subdivision 7 of the motion of the complainant herein, wherein it is asked that the court direct the state of Minnesota to pay for the printing of all parts of the record made by it; as contrary to the rules of this court, and unwarranted; and in that behalf it says:

Simultaneously with the bringing of this action, which is original action No. 27, the same attorneys who appear as counsel for complainant, brought an original suit in this court (No. 28) entitled State of South Dakota against State of Minnesota. The cause of action is identical with that of No. 27, and is for alleged injury to lands lying south of the southern boundary of North Dakota from the same cause and at the same time.

Before the taking of testimony in the North Dakota case, and at the request and solicitation of counsel representing both complaining states, defendant entered into a stipulation duly

filed in this court on June 4, 1917, agreeing that, since the lands affected in both the complaining states were contiguous, all evidence as to general conditions affecting the entire area might be taken in the North Dakota suit should be considered as applicable to the South Dakota suit and should not again be taken; but all such evidence might be used and be deemed to have been given in the South Dakota case. We print this stipulation in an appendix hereto for the convenience of the court.

The record now before the court in behalf of defendant is, of necessity, its defense to both suits. The state of South Dakota likewise demands from the State of Minnesota the sum of $1,000,000 damages and a perpetual injunction against the maintenance of the Mutsinka state ditch. The importance, therefore, of the state of Minnesota putting in all its evidence in defense of these suits is readily perceived. The stipulation that the evidence should be considered as applicable to both cases was made as a favor to the counsel representing both complaining states, and in the interest of their convenience and economy. The unfairness and injustice of now charging defendant with intentionally swelling the record to inordinate proportions because its entire defense to both actions was put in at the express request of opposing counsel is obvious and need not be further discussed.

After the completion of the taking of testimony in the North Dakota action counsel for the two complaining states requested another stipulation dispensing with the reproduction of the major part of the defendant's exhibits, which stipulation was promptly and cheerfully made.

It will be noted that all of the records and documents which now cause counsel for complainant so much heat are expressly stipulated not to be reproduced in the printed record, but to be

made a part of the record only by reference. It may not be out of place to state that the state of Minnesota provided in its Capitol building a room for the taking of the testimony; that it furnished a stenographer, paid all its witnesses, paid one-half of the commissioner's compensation, and has expended upwards of $10,000 in making its defense thus far. It has extended to counsel for complainant every possible courtesy in the matter of time, convenience and otherwise, its only recompense being the unfair and unjust charges now made against it by counsel for the complaining states.

The affidavit of John E. Palmer, Assistant Attorney General of Minnesota and a counsellor of this court, is filed herewith and a copy will be found in the appendix. It shows that all testimony given by defendant was in the best of good faith after full consultation with the then attorney general, the Honorable Lyndon A. Smith. The death of General Smith in March, 1918, deprives the defendant of the benefit of his affidavit upon these matters; but his eminent standing professionally and personally should be a complete refutation of the charge here made that he has taken advantage of the privileges of this court to do a dishonorable act.

The affidavit of Mr. Palmer further shows that the record consists in round numbers of 3,400 pages, of which 1,400 are taken up by the complainant and 2,000 by the defendant. The testimony to establish a prima facie case of complainant was opinion evidence by so-called experts, and was naturally and properly much shorter than the cross-examination which was designed to show the fallacies in their testimony. One of these experts, Ralph, claimed to have a personal knowledge of the conditions in the affected area, running back a number of years. Necessarily this witness was thoroughly cross-exam-

ined, but an inspection of the record will show, we think, every question to have a material bearing upon the issues. In view of the testimony of these experts, it was necessary to go back to the earliest settlement of the affected areas and show that the same conditions obtained long before the construction of the Mustinka State Ditch. Defendant submitted charts and diagrams showing the annual rainfall both before and after the construction of the ditch, which documents were based upon Government records. It was deemed necessary, or at least proper, to place certified copies of all these records in evidence in order that they might be before counsel and the court for reference if necessary to show the correctness of the charts and diagrams submitted, but it has been stipulated that all such exhibits shall be used for reference only and need not be reproduced.

As to the assessment books, the affidavit of Mr. Palmer shows that the testimony of the witness, Ralph, was to the effect that the three townships in Traverse county, Minnesota, known as Clifton, Redpath and Tintah, were in the year 1895 and prior thereto (being the years prior to the construction of the ditch), a lake surface and watery waste, a swamp covered for a large portion of the year with water to a considerable depth; that said lake surface was 75 square miles in extent, and that it is designated on the map attached to the complainant's bill of complaint as Exhibit "A," as the "Delta Zone." A large number of settlers living on this area were produced by defendant, and the assessment books of these townships for 1895 were put in evidence for the purpose of showing that this very area claimed by the witness, Ralph, to be a lake surface, comprised approximately 130 improved and cultivated farms with buildings, fences, etc. The assessment books for 1895 show the dif-

ferent farms within this so-called lake surface, their structures and the number of acres under cultivation. This testimony, therefore, was highly material.

To show the materiality of the testimony offered by the defendant, let it be noted, that the bill of complaint alleges that some 12,000 acres of land in North Dakota were inundated by reason of the Mustinka State Ditch in Minnesota during the years 1915 and 1916, and it is alleged that all said lands were owned by citizens of North Dakota; that they comprised eighty cultivated farms improved and in a high state of cultivation, and were among the most valuable, fertile and productive in the entire domain of North Dakota. It is alleged that the farm structures exceeded in value $250,000, and that the public buildings and bridges exceeded $35,000, all of which were destroyed. Cross-examination, of which counsel now complain, demonstrates that only about 5,000 acres was affected in any manner, that instead of eighty farms, there are but forty-three even remotely affected, that only twenty-four had buildings, that only eight had buildings affected by the water; that there were but thirty-eight owners affected, and instead of all being citizens of North Dakota, twenty-two were citizens of other states, five were citizens of Minnesota, and only sixteen were citizens of North Dakota. It was further shown that all these lands were subject to floods long before the construction of the Mustinka State Ditch in Minnesota; that they were of little value; that there were no public buildings thereon except one school house of the value of $350, and which was unaffected, and that there were no bridges destroyed or injured.

It was further shown by the cross-examination that the owners of these lands had contributed by private subscription $4,000 with which to have this action instituted, and that they

did so with the understanding and agreement that North Dakota would appropriate to them from any damages recovered from Minnesota the amount of damage testified to by them. Surely all this is highly material.

It is alleged in the bill of complaint that the construction of the Mustinka State Ditch raised the area of Lake Traverse approximately five feet above normal high water mark. The cross-examination of the complainant's experts reduced this to ten inches with the Witnesses Shenehon and Chandler, and to eighteen inches to one foot by the witness Ralph. These matters were certainly material.

The cross-examination of the witnesses for complainant, and direct examination of some of the witnesses for defendant, shows conclusively that large areas in the states of North Dakota and South Dakota were drained into Traverse Lake by artificial means, during the years in controversy, also that the rainfall in 1914, 1915 and 1916 exceeded the rainfall of all previous years in the history of that part of the country, all of which went directly to a refutation of the matters alleged in the bill and testified to by witnesses for complainant.

It is true that a large number of photographs were offered by defendant for the purpose of showing conditions upon the affected area, but it is expressly stipulated that none of such photographs need be reproduced and may be used only for reference at the convenience of the court. Likewise the quadrangles and surveys by the federal authorities were offered, but only as matters of reference, and under the stipulation these are not to be printed.

It is also shown by the affidavit of Mr. Palmer that during the taking of the testimony he called the attention of counsel for complainant to a number of repetitions that were being

brought into the record. This over-lapping of testimony and these repetitions arose largely from the fact that the labor of putting in the evidence was divided among counsel for complainant. Mr. Boutelle put in the evidence of the expert witnesses, Mr. Pinkney the evidence of damages, and Mr. Bronson the evidence of general conditions. Very seldom were all of these counsel present at the taking of the testimony, and as a result no one of them knows about the record as an entirety. The serious charges here made against the attorney general of Minnesota are, we are informed, made by the counsel who was present the least, and who knows the least about the record. On the contrary, the state of Minnesota was represented throughout by one counsel, and we assure the court that the record will be found to contain the defendant's case as an harmonious whole, no part of which could be safely dispensed with.

We make no answer in kind to the charges made by counsel who in fact represent these land owners; but respectfully submit that the whole motion in behalf of complainant should be denied for want of equity in the bill of complaint; or, if it be granted, that there is no just reason for ordering the state of Minnesota to pay for the presentation of complainant's case to this court.

Respectfully submitted:

CLIFFORD L. HILTON,
Attorney General,
JOHN E. PALMER,
Assistant Attorney General,
Solicitors for Defendant.

APPENDIX.

UNITED STATES OF AMERICA.

IN SUPREME COURT.

No. 27.

THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA,

Defendant.

No. 28.

THE STATE OF SOUTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA,

Defendant.

It is stipulated by all parties to the second of the above entitled actions that, if deemed proper, an order similar to that of April 30, 1917, made in the first of said actions, may now be

made by the court in the second of said actions appointing the Honorable Wallace B. Douglas Commissioner to take and report the evidence therein; that all of the evidence in the first of said actions shall be first adduced; that the parties to the second of said actions may then agree upon such evidence as shall be considered applicable to the second of said actions, and such evidence shall not again be taken, but may be used and deemed to have been given in the second of said actions. Such evidence shall, however, be separated and separately printed and returned by the Commissioner in each of said actions; that the evidence in the second of said actions other than that so taken in the first, as aforesaid, shall be adduced only after that in the first action is closed; and each party allowed such additional time as may be necessary on account of the trial of the second of said actions. The Commissioner shall determine and certify to the time consumed in the taking of the evidence so made applicable to both actions, and shall be entitled to double per diem for taking and certifying such evidence, to-wit, ten dollars ($10) per day in each of said actions.

This stipulation shall not be construed as an agreement to in any manner consolidate said actions, but is made solely for the purpose of convenience and economy.

Dated June 2, 1917.

CLARENCE C. CALDWELL,
Attorney for Complainant, State of South Dakota.

LYNDON A. SMITH,
Attorney for Defendant, State of Minnesota.

AFFIDAVIT OF JOHN E. PALMER.

STATE OF MINNESOTA,

County of Ramsey. ss.

John E. Palmer, being duly sworn, says that he is, and at all times herein mentioned was, an assistant attorney general of the state of Minnesota, duly admitted to practice in the Supreme Court of the United States; that he acted as counsel for the State of Minnesota in the taking of evidence before the commissioner in Original Action No. 27 in the Supreme Court of the United States, being The State of North Dakota against the State of Minnesota; that he prepared the defense in said action in behalf of the state of Minnesota, and conducted the taking of the testimony in its behalf upon the several hearings before the commissioner appointed by said court; that affiant prepared the entire defense of the state and attended upon all the hearings, examined all witnesses, upon both direct and cross-examination, and has attentatively read the record taken in said cause and is thoroughly familiar with the same; that the record herein consists, in round numbers, of 3,400 typewritten pages, of which 1,400 are taken up by complainant and 2,000 by defendant.

That upon the taking of said testimony, complainant was represented by three counsel, to-wit: M. H. Boutelle, I. C. Pinkney and H. A. Bronson. That on the part of the complainant said Boutelle put in the testimony of the expert witnesses; said Pinkney that of the damages claimed to have been suffered by land owners; and said Bronson that relating to general conditions upon the areas affected; that a portion of the time, only the counsel putting in the testimony was present, that at other

times two were present, and that all three were present but a very small part of the time; that as a result, there appears in the records considerable repetition and overlapping of testimony on the part of the complainant.

That the prima facie case of complainant was attempted to be made by three alleged experts,—Ralph, Shenehon and Chandler; that the witness Ralph was formerly the state engineer of the state of Minnesota, and the drainage ditch complained of was planned by him and made under his direction; that the employment of said witness with the state of Minnesota ceased shortly before the completion of said ditch, and thereafter he became active in behalf of the state of North Dakota; that said Ralph claimed to have had a personal knowledge of conditions upon the areas affected for a great number of years; that said Ralph testified in substance that about 75 square miles in the townships of Clifton, Redpath and Tintah in Traverse county, Minnesota, were, in the year 1895 and prior thereto, a lake surface covered with water to a substantial depth and producing only rushes and acquatic grasses. It became necessary to show by his cross-examination, by the tax books of said townships for 1895 and by the testimony of settlers upon said area, that said area claimed by the witness Ralph to be a lake surface in Minnesota, (and designated on the map Exhibit "A" attached to complainant's bill of complaint as "Delta Zone") was in fact in 1895 and many years prior thereto, approximately 130 improved and cultivated farms with buildings, fences and other improvements. The tax books of 1895 for said townships show the assessed valuation of said farms, the structures thereon, and the acres under cultivation, and were therefore very material upon said issue.

It was testified by said experts that in their opinion the flood

ing of the lands along the westerly side of the Bois de Sioux river in North Dakota was due to the Mustinka State Ditch in Minnesota; and it became necessary for defendant to adduce testimony and rainfall charts and Government records showing the rainfall upon the territory affected during the years 1914, 1915 and 1916, to be the greatest known in the history of that area; that in the preparation of charts and diagrams showing said fact it was necessary to use a great number of Government records, certified copies of which were offered in evidence solely for reference purposes, and to show the accuracy of said charts and diagrams.

That it was necessary to submit photographs, statistics and testimony of settlers showing that in the years 1914, 1915 and 1916, the Mustinka State Ditch did not carry the water from the lands in Minnesota designed to be drained thereby, but that more water stood upon said lands during said years than in any previous years, and that no water was diverted from its natural course by said ditch.

That the record shows that only about 5,000 acres of lands in North Dakota were affected by the flooded conditions of 1915 and 1916, that said area comprises only forty-three farms, with thirty-eight separate owners, that of said forty-three farms only twenty-four have any buildings or improvements, that only eight had buildings affected by the water; that of said thirty-eight owners only sixteen were citizens of North Dakota, and twenty-two were non-residents and citizens of other states, and that five were citizens of Minnesota. It is further shown that said lands were subject to repeated flooding long prior to the construction of any ditches in Minnesota. Also it was shown that the major portion of said lands were either in a wild state, or an exceedingly poor state of cultivation, that the buildings

thereon, if any, were in general very poor and that said land had been used largely as "trading stock" so-called; that on said area there were no public buildings except one school house of the value of about $350, which was unaffected by the alleged floods, and that no bridges were injured or destroyed. It was necessary, in order to show said matters, to cross-examine witnesses for the complainant at some length.

It was further shown that said land owners had contributed privately about $4,000 toward the institution and expenses of this action and to hire the private counsel engaged therein in behalf of the complainant; that such contributions had been made upon the understanding and agreement that North Dakota would appropriate to them their damages out of any money recovered from Minnesota herein.

That contemporaneously with the bringing of the cause now before the court, the same counsel who appear as counsel for complainant, brought an action for the State of South Dakota against the State of Minnesota founded upon the same matters set forth in the bill of complaint in the North Dakota action. That the territory alleged to be affected in South Dakota is contiguous to that alleged to be affected in North Dakota; that before the taking of any testimony in the North Dakota action said counsel requested the attorney general of Minnesota to enter into a stipulation that the testimony, as to all general conditions, should be taken in the North Dakota case, and need not be retaken in the South Dakota case, but could be used therein so far as found applicable; that said stipulation was entered into by request of the counsel common in both causes and in the interest of their convenience and economy; and that by reason of said stipulation it was necessary for the state of Minnesota to put in in the North Dakota case all of its testimony in

defense of both actions, save only that given in defense to claimed damages to lands in South Dakota.

That the state of Minnesota has already expended in said matter $9,456.73; that it provided a room in its Capitol building for the taking of said testimony; that it has made numerous concessions to counsel for complainant as to time and convenience in the taking of the testimony.

Affiant further states that before any testimony was introduced in behalf of defendant, a conference was held thereon with the Honorable Lyndon A. Smith, then attorney general of Minnesota, and no testimony was introduced except upon his approval and by his direction. No testimony, exhibit, objection or proceedings was offered, made or taken upon the part of defendant for the purpose of swelling the record or taking advantage of the fact that the testimony was being taken before a commissioner, but all said matters in behalf of the defendant were offered in good faith and in the firm belief of their necescity and materiality. Several times during said hearings affiant courteously called attention of counsel for complainant to repetitions in the testimony and some questions which did not appear strictly necessary; that counsel for complainant thereupon assured affiant that they would go over the record with affiant and would stipulate for the elimination of all repetitions and everything necessary to make the record as concise as possible, and that most of the exhibits could be offered for the purpose of reference only for counsel and the court, but since the taking of said testimony counsel for complainant have declined to go over said record and agree upon the elimination of such repetitions as appear therein. However counsel for complainant have requested the making of a stipulation dispensing with the reproduction of the major part of the defend-

ant's exhibits, which stipulation counsel for the State of Minnesota have made.

John L. Salmon

Subscribed and sworn to before me this tenth day of December, 1918.

G. K. Strangenberg

Notary Public,
Ramsey County, Minnesota.

My commission expires March 11, 1922.

Office Supreme Court, U.
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IN THE

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1922.

No. [redacted] Original.

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THE STATE OF NORTH DAKOTA,
Complainant,

vs.

THE STATE OF MINNESOTA.

BRIEF ON ADDITIONAL RECORD FOR AND ON BEHALF OF MINNESOTA.

CLIFFORD L. HILTON,
Attorney General,

EGBERT S. OAKLEY,
Deputy Attorney General, and

MONTREVILLE J. BROWN,
Assistant Attorney General,
for Minnesota.

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IN THE

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1922.

No. 11, Original.

THE STATE OF NORTH DAKOTA,

Complainant.

vs.

THE STATE OF MINNESOTA.

BRIEF ON ADDITIONAL RECORD FOR AND ON BEHALF OF MINNESOTA.

This cause comes before the court a second time by reason of its order of April 18, 1921, which restored the case to the docket, and directed that supplemental proof be taken on three general subjects. The subjects are: (1) The possibility, within the limits of a reasonable expenditure, of doing away with or ameliorating the flood conditions along the Bois de Sioux River, by means other than

the injunction prayed for in the bill, the testimony thus to be taken to be partly directed, among other things, to the possibility and effect and estimated cost of any of five suggested projects; (2) The proper, equitable basis for apportioning the expense of any feasible project among the states drained by the Lake Traverse-Bois de Sioux watershed, taking into account, among other considerations, the amount of water discharged by each state into Lake Traverse or the Bois de Sioux River, and the benefit conferred by the improvement; and (3) Flood conditions which have prevailed, since the filing of the bill, in the area claimed to have been flooded by the action of the state of Minnesota. In July, 1922, a hearing was held pursuant to this order, and testimony taken on these subjects. The testimony has been returned and the cause is here for argument in the light thereof.

In view of the fact that a great deal of what we shall say will center around the testimony of our engineering experts, we desire at the outset to direct the court's attention to their qualifications. Nothing need here be said as to Professor Bass. His qualifications are covered in our previous brief; he having appeared as a witness for Minnesota at the original hearing. The other experts called into the case are Professor Adolph F. Meyer, of Minneapolis, Minnesota, and Mr. Arthur E. Morgan, of Dayton, Ohio. It is with respect to their qualifications that we propose to enlighten the court.

Professor Meyer graduated from the University of Wisconsin in 1905, and since has specilized in hydraulic engineering work. For a number of years he was in the government service on river improvement works, reservoir construction near the head waters of the Mississippi River. About five years he was consulting engineer to the International Joint Commission which had under consideration the utilization and control of the waters of the Lake of the Woods and those tributary thereto for a variety of purposes. He has been and is now acting as consulting engineer to the Minnesota State Department of Drainage, in connection with various flood control projects, such as those on the Red Lake River, the Red Lakes and the Minnesota River. He has also been associate professor of hydraulic engineering at the University of Minnesota, and professorial lecturer there for several years (Add. rec. p. 32).

Mr. Morgan resides at Yellow Springs, Ohio. He is a hydraulic and flood control engineer of twenty years' experience. He is president of the Morgan Engineering Company, with principal places of business at Dayton, Ohio, and Memphis, Tennessee. He has been and is now in charge of the construction and installation of numerous flood control works, some of great magnitude, as disclosed by the following from his testimony:

> "Some of the first work that I did was in Minnesota, in planning relief from overflow and floods of various streams in this state. Those included the upper courses of

Clear Water River, Crow River, Rice River in Lincoln county, and along Prairie River, Sauk River and the Mustinka River and various other streams, and in the southern states the reclamation and control of overflowed lands in Texas, Louisiana, Arkansas, Missouri, Tennessee, Mississippi and Florida. Those in the aggregate I have had under my direction that has resulted in the construction of various retarding basins, and perhaps 500 miles of levees, perhaps 3,000 miles of canals, and it included the reclamation of, at a rough guess, I should say 2,000,000 acres of overflow lands. * * * Then in Ohio I have been in charge, as chief engineer and in charge of construction, of flood control works on the Miami River and its tributaries, on the upper Scioto River, and I am now in charge in Colorado of some work for the protection of the city of Pueblo from floods on the Arkansas River. During that period that I have mentioned I have been in charge of somewhere between seventy-five and one hundred reclamation and flood control problems, of a total cost of possibly $75,000,000, of which, however, one project, that in Ohio, represents almost half in money" (Record, pp 70 and 71).

Mr. Morgan also spent about three years in the office of the Federal government in what was at the time called the Department of Drainage Investigations. It is the same organization that produced Buletin No. 1017 which will be hereinafter referred to. He was, during this time, supervising engineer in charge of various of their projects.

All of Minnesota's engineering experts, preparatory to giving testimony, spent considerable time on the ground, Lake Traverse, Bois de Sioux and Mustinka watersheds, and made the necessary investigation as to material facts and conditions (Meyer, add. rec. pp. 53 and 54; Morgan, add. rec. pp. 71 and 72).

I.

North Dakota's Interpretation of the Order.

At the hearing, complainant proceeded on the theory that the question whether Minnesota's drainage system materially contributed to the floods of 1915 and 1916 was settled adversely to her; and that the sole purpose of directing that additional testimony be taken was to advise the court whether relief against a recurrence of the trespass other than by way of injunction could be afforded North Dakota. The case is argued in complainant's brief on this theory. Just how anyone could be so misled by the wording of the order as to proceed on any such theory is beyond our comprehension. There is nothing in the order indicating that the court had, at the time of its release, reached the conclusion that this drainage system had caused a portion of each of the floods of 1915 and 1916, characterized by complainant's witnesses and in complainant's brief as, "the excess floods"; and that flooding would be caused thereby in the future. That it had not reached such a conclusion is, to our minds, patent on the face of the order.

If it had, why was anything said in the order about apportioning the expense of any feasible project among the states drained by the Lake Traverse-Bois de Sioux watershed? Would not the court, if any such thing had been in mind, have brought the order to a close at the end of the first paragraph thereof—the paragraph which directs that testimony be taken as to the possibility of doing away with or ameliorating flood conditions along the Bois de Sioux River by means other than the injunction prayed for? But the court did not stop there. It directed that testimony be taken as to the equitable basis for apportioning the expense of a project deemed feasible among several states, and went further and directed that testimony be taken as to the flood conditions which have prevailed since the filing of the bill. If it had reached the conclusion that Minnesota had contributed to the floods of 1915 and 1916, and wanted to know whether a scheme could be worked out to take care of like future contributions, it would have remained silent on the question of apportioning the expense, for the whole thereof would have been considered a charge against Minnesota; and would have remained silent with respect to flood conditions which have prevailed since the filing of the bill, for these would have been looked upon as wholly immaterial. These directions for additional testimony make it self-evident that the court had not reached the conclusion at the time of its order contended for by complainant; and complainant, in taking its testimony and in preparing

its printed argument, proceeded on an erroneous interpretation of the order, and as a consequence, a great deal of what is said in its brief may be passed over without comment.

II.

Minnesota's Interpretation of the Order.

The order directed the taking of testimony on three subjects, as heretofore stated. Minnesota offered testimony on all of these subjects. Complainant, in its brief, criticizes her for doing so with reference to the second subject enumerated in the order; namely, the apportionment of the cost of a project deemed feasible among the states drained into Lake Traverse or the Bois de Sioux River, taking into account, among other considerations, the amount of water discharged by each state into Lake Traverse or the Bois de Sioux River, and the benefit conferred by the improvement. The basis of the criticism is that Minnesota improperly reopened features of the case presented on the original hearing; complainant in its brief says: "Exhaustively presented on the original hearing." If the presentation made by North Dakota is what complainant had in mind in making this statement we submit that such presentation was to such a large extent based on unsupported assumptions of fact as to be of no persuasive force. Minnesota at the hearing offered testimony on apportioning the cost of the project deemed feasible by it among the

states of North Dakota, South Dakota and Minnesota. It was directed in doing this to take into account the amount of water discharged by each of these states into Lake Traverse and the Bois de Sioux River. It was impossible for the witnesses to do this without knowing definitely whether there were any discharges, and if so, the extent of each. The first thing incumbent upon them then was to ascertain the effect of artificial drainage on flood conditions in the Bois de Sioux valley. Studies were made with reference to Minnesota's drainage system—the one complained of—and directed toward ascertaining whether this system in times of flood in the Bois de Sioux valley contributes waters which would not be contributed in a state of nature; and this for the purpose of arriving at an equitable basis of apportioning the cost, taking into account the amount of water contributed by Minnesota. These studies naturally necessitated a consideration, among other things, of records of run-off and precipitation over the several watersheds involved. The conclusion reached was that the drainage system does not contribute waters to floods in the Bois de Sioux valley over and above what are contributed in a state of nature. They testified to this effect on the stand, and explained how and why they reached such conclusion; and all for the purpose of enabling them to express an opinion as to how the costs should be apportioned among the states, taking into account the amount of waters contributed by each, and the benefit conferred by the improvement.

They testified, in view of this conclusion as to the effect of Minnesota's drainage system on the flood situation in the Bois de Sioux valley, that the expense should be apportioned among the states on the basis of benefits conferred. Such was the course pursued by Minnesota upon the hearing. To our minds, it was the one rendered necessary of employment by the court's order. We submit that the criticism made time and time again in North Dakota's brief of the character of testimony offered by Minnesota is without the slightest justification.

This is sufficient to explain Minnesota's interpretation of the court's order. The testimony just referred to will be discussed at length later in the brief.

III.

Projects Suggested by the Order Considered.

The engineering experts of both sides agree that all projects suggested by the order, save project (c)—artificial improvement in the channel of the Bois de Sioux River and the construction of a sluice dam at the foot of Lake Traverse—must be eliminated from consideration. In their opinion, they are not feasible. The reasons given by all as to projects (b), (d) and (e) are, in essential respects, the same. In view of the situation we shall not devote any time to a consideration of these projects. (Shenehon, add. rec. pp. 2, 3 and 4; Chandler, add. rec. pp. 21 and 22; Meyer, add. rec. pp.

33 and 34; Morgan, add. rec. pp. 72 and 73).

With respect to project (a), it might be inferred from the statement contained in complainant's supplemental brief, at the bottom of page 12, that there are locations in the Mustinka watershed for the construction of detaining basins. This statement reads as follows: "In substance, the objection to project (a) is that the cost of constructing detaining basins in the Mustinka watershed would be prohibitive and involve damage to large areas therein." This was undoubtedly prompted by the testimony of Dean Shenehon, as set forth on page 3 of the additional record, where he said, in response to a question as to the feasibility or practicability of constructing detaining basins for use in the watershed area of the Mustinka River: "Physically practicable, financially not feasible." From this, it might be inferred that a site or sites exist in the so-called delta zone. There is no location in this zone for a detaining basin. On this point, Professor Meyer testified as follows:

> "In my judgment, there is no satisfactory site for a detaining basin within the delta zone because of the gradual slope of the land throughout that area. There is nowhere a sufficiently cupped shape or natural site to furnish a satisfactory detaining basin within that zone" (Add. rec. p. 33).

Professor Bass and Mr. Morgan expressed themselves to the same effect. This is disclosed from a reading of their testimony. The testimony of Professor Bass will be found at the bottom of page

88 of the additional record; and that of Mr. Morgan at the bottom of page 72, and on pages 80, 81 and 82 of the additional record.

IV.

Project Proposed by Minnesota.

Minnesota's experts recommend a project costing approximately $450,000; the same to consist of a dam with sluices, at the foot of Lake Traverse, and an enlarged channel for the Bois de Sioux River, about 30 feet wide at the bottom and 10 to 12 feet deep. Lake Traverse is to be lowered about 2 or 3 feet during the winter, as may be necessary to insure its capacity as a detaining basin. We here set forth portions of the testimony of Professor Meyer and Mr. Morgan, which outline and explain this project in detail, the plan of operation thereof, and the results to be expected therefrom. In this way, we feel that the court will get a better understanding of the project than were we to attempt to give the substance of the testimony on the subject.

Testimony of Professor Meyer, starting near the top of page 37 and continuing to the middle of page 40 of the additional record:

> "Q. Will you state in your own way the consideration you have given to the matter of installing some sort of project there to do away with or ameliorate flood conditions in the region complained of.

A. I have considered the excavation of various sizes of channels from the outlet of Lake Traverse to a short distance below the Rabbit River. I have also considered the lowering of Lake Traverse in the fall and winter to various levels, and the construction of controlling works at the outlet to various elevations. I consider that a project involving an expenditure of, roughly speaking, a half a million dollars, as sufficient to protect the lands along the Bois de Sioux River from nearly all floods, and as waranted by the benefit which would be conferred upon the area saved from overflow and the area which could be drained into the improved channel. I don't know whether you care to have me go into it any further at the present time in a discussion of the details.

Q. To what capacity do you propose to dredge the Bois de Sioux?

A. In my judgment it would be desirable to dredge the Bois de Sioux River to a capacity of about 700 cubic feet per second at the upper end, increasing in capacity to about 1,000 or 1,100 second feet at the mouth of the Rabbit River. I have not the exact dimensions in mind, because various sections would give that capacity. The best section would be rather a deep section, so as to give the best outlet facilities for the adjacent lands. I have not in mind the exact dimensions of the channel.

Q. Where would you commence with the enlargement of the channel, approximately?

A. An approach channel would require to be dredged to carry the water to the control works dam, and when it is desired to draw Lake Traverse down. Then this channel would

commence at the control works, to be located about four or five miles south of White Rock, and would extend from the control works up to a point a short distance below the mouth of Rabbit River.

Q. You said that your control works would be stationed five miles south of White Rock?

A. Yes, sir.

Q. What sort of control works have you in mind.

A. I had in mind a control dam, with gates, so that the discharge from the lake can at all times be regulated, and a supplementary spillway over the natural ground level slightly prepared for such purpose, where this had an elevation of about 74.5 or 75, varying from 74 to 75 with the exact project which would finally be found the most economical. The concrete portion of the dam would be, of course, located in the excavated channel, and would be planned with a view to the possible future extension and enlargement of the flood protection project.

Q. At what elevation would you have this dam you propose?

A. I would propose the spillway itself to be at an elevation varying between 74 and 75. It is not entirely fixed in my mind as to which would be found the most economical, that is, the supplementary spillway. The base of the dyke can advantageously be carried up sufficiently high to prevent the possibility of any of the earthwork washing out. This, however, would be very short sections; for most of the distance across the valley there would be a relatively small amount of embankment work to be done. In my judgment the western out-

let should be closed and all of the water, or substantially all of the water, discharged through the main Bois de Sioux Channel, through the controlling works mentioned.

Q. You propose then, as I understand it, to construct a dyke or dam across the whole valley?

A. Substantially across the valley, but very low in most of the distance across.

Mr. Boutelle:

Q. What are you referring to by the 'western outlet?'

A. As indicated on the maps which are now in evidence. There is an outlet known as the western outlet.

Mr. Brown:

Q. You referred in one of your answers to the proposition that the dam you now propose is one which could be later on enlarged in view of the installation of some larger project. What have you to say in that regard with respect to the dredging out of the Bois de Sioux River?

A. The Bois de Sioux River, in my judgment, should be enlarged to substantially the maximum capacity that could be justified by the benefits which will be conferred so that even the very rare floods may at some time in the future be entirely prevented if that becomes economically justified.

Q. Now, Mr. Meyer, how do you propose to increase the effect of Lake Traverse as a detaining basin?

A. I propose by means of this approach channel which is to be dredged to the control works

to lower the lake in the late fall and winter so as to provide additional storage capacity for the spring run-off, and then to bring the lake up again to a level which will be satisfactory for navigation purposes, particularly during the late summer and early fall when most of the navigation is carried on, at the time when they are moving the grain to Brown's Valley for shipment. I would propose to lower the level in the winter time to an extent depending upon the fall and winter meteorological conditions, having reference to the extent and character of precipitation, temperature and all other factors having a bearing upon the probable spring run-off. Preceding an expected extremely heavy run-off, I would propose to lower the lake to about 970. During other years I would propose to lower it a lesser amount.

Q. How would the low water level which you have in mind in connection with your project compare with the level of Lake Traverse before the spring breakup in 1916?

A. In my judgment the level would be about 3 feet lower than it actually was in the early spring before the breakup in 1916.

Q. In your answer to the last question do I understand that you meant that in the winter of 1915-1916 by the controlling works which you have proposed you could have drawn the lake down to substantially 970, so that you would have say about three feet leeway at the time of the spring run-off?

A. In my judgment the proposed approach channel and control works would have permitted drawing down the lake to a level which in my judgment would have been substantially

three feet lower than it probably was before the spring breakup in 1916.

Q. How would your project have functioned in a spring such as the spring of 1916?

A. Starting out with a much lower level it would have been possible to store the amount of water which did run into the lake, other conditions being equal, without having the lake rise to as high a flood stage. In addition to that, the larger Bois de Sioux River and the capacity of the control works at the outlet would have permitted the discharge of larger quantities of water during the earlier flood stage, and also quantities of water during the later flood stages, and in this way the project would have prevented substantially all or most of the overflow in the Bois de Sioux valley and would also have prevented the lake from reaching the level it did reach in 1916.

Q. Do you propose to raise the level of Lake Traverse under any circumstances, that is, as the result of the installation of your project?

A. No, sir. The control works that I have in mind are to be planned with a view to the lake level never exceeding its natural stage under the same conditions.

Q. Then it will not be necessary, in considering the matter of installing your project, to take into consideration flowage rights?

A. It would not be necessary. In my judgment it would not be necessary to acquire any flowage rights.

Q. What effect will the installation of this project, if it should be installed, have on navigation interests in the lake?

A. In my judgment the proposed regulation will, on the whole, be beneficial to navigation.

Q. Will you explain that a little more in detail?

A. By being able to completely close off the outlet during dry years and portions of dry years, so as to prevent any outflow whatsoever approaching the low stage in Lake Traverse, it will be possible to make better use of such inflow as there is and maintain the lake at a better stage. During several years that are extremely dry there is a possibility—at the same time starting out with a lower level—that the lake might possibly during the navigation season, once in possibly twenty-five years or more, be slightly lower than it would have been if this control had not been in effect. But to offset that, in my judgment, would be the far greater benefit resulting from the better navigable stage which could be maintained in the lake during the late summer and early fall, when most of the grain transportation takes place. So, in my judgment, the sum total of regulation will be decidedly beneficial to navigation.

Q. Will the complete closing of the control works result in damage to any riparian owners on the Bois de Sioux River?

A. In my judgment it would not because at the present time the records show that the outflow is zero for considerable periods.

Q. Perhaps you have explained it already, I will ask it nevertheless. How do you propose to restore the normal lake level in the spring?

A. By closing the control works early in the spring, whenever it is apparent that the available storage capacity is amply sufficient to take care of the spring run-off without raising the lake level to higher than is necessary or desirable for navigation purposes. In other words, I propose to utilize the early spring inflow to whatever extent necessary to restore the lake level to a satisfactory navigable stage, without permitting it to raise to a stage unnecessary for this purpose. In that way the storage capacity for later floods is also increased."

Testimony of Mr. Morgan, starting at the bottom of page 74 and continuing to the top of page 77 of the additional record:

"Q. Are you of opinion that some project can be constructed in the Lake Traverse-Bois de Sioux region which if installed would do away with or ameliorate flood conditions in the Bois de Sioux valley?

A. Yes.

Q. Have you considered such a project?

A. Yes.

Q. Just what sort of a project, Mr. Morgan, would you recommend?

A. I would recommend a project in general along the lines of that recommended in Bulletin 1017 but carried only to the extent that would be justified by the present values of lands and interests at stake, but which would be susceptible to further development without material loss of investment if in the future the increase of land values and increase of interests should lead the communities affected to desire to carry the project further.

Q. What improvements do you have in mind?

A. I believe that an improvement costing between $400,000 and $500,000, and perhaps somewhat more than that, would be justified at the present time; that that improvement should consist of a channel enlargement of the Bois de Sioux River, extending from a bottom elevation of about 965 in Lake Traverse, thence down-stream to a point about ten miles below the outlet of Rabbit River, downstream from the outlet of the Rabbit River; that the capacity of this channel from Lake Traverse to the outlet of the Rabbit River is recommended to be 700 cubic feet per second at bank full stage, and from the mouth of Rabbit River north 1,000 cubic feet per second at bank full stage. In addition to the construction of this channel, which would cost about $225,000, it would be necessary to replace highway bridges at an expense of about $15,000 and to pay damages for the cutting of the ditch to an extent of perhaps $25,000. Then I would recommend building a dam across Lake Traverse to an elevation of about 978, with a spillway elevation of about 974. There is a large flat area at the dam site at about elevation of 973 to 975, which would form a natural spillway and would prevent danger to the floor of the dam. The top of the dam might possibly be 980; it should be well above the spillway elevation.

Q. Where do you propose to locate this dam?

A. At approximately the location indicated in Bulletin 1017. The exact location could be determined after a careful examination of

the ground to determine where the best foundation would be. It would be an earth dam and through the earth dam and cut in the earth dam would be a concrete structure of the outlets. Those outlets would have a capacity of about 700 cubic feet per second, with an elevation not more than about one foot, which would give then a cross section of probably a little over 100 square feet. Possibly 200 square feet would be more effective.

Q. What sort of control do you suggest with reference to your outlet works?

A. The outlets would be controlled by gates which would be operated by hand.

Q. What would be the cost of that?

A. The cost of the dam and gates, etc., would be not to exceed $100,000. Then there would be possibly $50,000 of contingent expenses, more or less. So there would be somewhere in the neighborhood of $400,000. I should say that $40,000 would be nearer right for contingencies.

Q. How will this project operate as a preventative of floods in the Bois de Sioux valley?

A. It would operate by releasing a part of the water in Lake Traverse during the winter, making the area of the lake above an elevation of 970 available for storage. That, in addition to a capacity of about 700 cubic feet per second in the channel below, would effectively take care of approximately such a condition as obtained in 1916.

Now the question of just how far to go in the extent of that improvement is not to be determined until a careful examination can be made of the interests involved. That will depend on the number of acres affected, upon

the extent of the effect upon those acres, and upon the value of the property, of the lands, at the time that improvement is carried out. Since this suit was commenced I think that land values in that general territory have increased possibly 50 per cent and then in the last two years they have decreased again with the general shrinkage of land values. If land values are high their reclamation justifies a greater expenditure. An expenditure of possibly $400,000 would be perhaps the most profitable. On more than that you would be getting diminishing returns and the exact place to stop in that area is somewhat indefinite. It would have to depend upon a careful appraisal of the results of that improvement and the prevailing values at that time, and it could only be determined by a very careful analysis of the situation.

Q. Do you propose to raise the level of Lake Traverse at all?

A. Not above what it would be under similar conditions in a state of nature, under similar climatic and flow conditions in a state of nature. In fact, it might be reduced possibly a foot in the case of a spring like 1913, possibly a foot below what would be in a state of nature.

Q. 1913?

A. 1916.

Q. You do not figure then that there will be any flowage rights along Lake Traverse to take care of in installing such a project as this?

A. I consider not.

Q. And what effect will the installation of your project have on navigation interests in Lake Traverse?

A. That I am not entirely certain about. It would have a different effect in one year than it would in another. There might be some years when the effect would be unfavorable; there would be other years when it would be distinctly favorable. As to how the balance would lie, I do not know, but I am quite certain it would be immaterial from a financial standpoint.

Q. How would you suggest operating this project during the spring run-offs?

A. As soon as the navigation season is closed in the fall, when there is ice on the lake, the gates should be opened to the full capacity of the channel outlets and the lake allowed to empty to an elevation of 970 and kept at that elevation until the water from melting snow had passed in the spring. Then it should be raised to about ordinary low water stage, say about 972, and held there during the summer. It would take some practice to know how to regulate that. We do not know how much seepage there is in the lake that would affect it. That would be a matter of experience to determine.

Q. I believe you stated that the project you suggest in your opinion would have prevented all conditions which occurred in the Bois de Sioux valley in 1916, is that true?

A. Yes, so far as those conditions were due to any flooding from Lake Traverse and so far as they would be affected by an enlargement of the Bois de Sioux River. There are some wet areas along there that would have to have additional drainage for their reclamation regardless of any outlet. In fact, that is true of a considerable portion of the area, but there

is a very great area there that would require additional ditching to make its condition of cultivation the best.

Q. I believe you stated that the project you suggest is one which may be enlarged in the future, if occasion should require?

A. Yes, it can be enlarged with practically no loss of investment."

Professor Bass testified along similar lines. (Add. rec. pp. 88-91).

North Dakota did not upon the hearing, nor does it in its brief, offer any criticism of the project proposed by Minnesota, nor challenge any of the foregoing testimony given by Professor Meyer and Mr. Morgan. What North Dakota does contend is that Minnesota's project is based upon a misinterpretation of the purposes of the court in directing that testimony be taken with respect to the suggested flood control projects. This is a matter which has heretofore been discussed.

V.

Project Proposed by Bulletin No. 1017, United States Department of Agriculture.

This bulletin sets forth a report on drainage and prevention of overflow in the valley of the Red River of the North, prepared by P. T. Simons, Senior Drainage Engineer, and Forest V. King, Drainage Engineer of the Bureau of Public Roads. These engineers, with their assistants, began field work in September, 1918, and completed the same

in April, 1920. The report is an exhaustive one, and covers many phases of the problem presented in the matter before us. Reference will be made to the report at subsequent points in our brief. For the present we propose to give consideration in a general way to the project suggested therein as one which will relieve the Bois de Sioux valley from floods.

The report has to do with flood and drainage problems connected with the entire area tributary to the Red River of the North. We find the following statements therein:

> "The work in the valley separates into three projects which can be carried out separately, or as one large project. These are the Lake Traverse-Bois de Sioux, the Red Lake—Red Lake River, and the Red River of the North projects." (Bulletin, p. 59).
>
> "The Lake Traverse-Bois de Sioux project is complete within itself. While it may, if desired, be included as a part of the larger Red River project, it can be prosecuted entirely independently of any other improvements." (Bulletin, p. 71).

The improvements recommended in the Lake Traverse-Bois de Sioux watershed are: (1) A detention reservoir to be formed in Lake Traverse by the construction of an earth dam providing for spillway and outlet control, and extending across the watershed and the adjacent low land near White Rock, S. D., and also an earth levee at the south end of the lake, near Brown's Valley,

Minnesota; (2) a new channel for the Bois de Sioux from the dam in Lake Traverse to a point near Wahpeton, N. D., where the natural channel will carry the water without flooding; and (3) a system of ditches to provide for the drainage in the areas to be reclaimed by the project. As stated, these improvements are designed to relieve flood conditions, make possible the reclamation of flood lands along the Bois de Sioux, and provide outlets for the drainage necessary to the development of this area. The details thereof are discussed and explained on pages 60 to 70, inclusive, of the report. We will not go into them.

The project is on a much larger scale than any suggested by the experts in this case, as is apparent from the estimated cost, $1,400,000; and differs from those suggested by these experts in one very material respect. It is expected that this project in times of flood will result in the overflow of lands around Lake Traverse. This is obviated in the plans heretofore discussed. A different principal underlies the utilization of Lake Traverse as a detaining basin. Under the scheme of the engineers in this case, the level of the water in the lake is to be brought down in anticipation of a flood so that when it comes, the level of the lake will not go above what it would in a state of nature. Under the plan of the government engineers, it is proposed to increase the capacity of the lake so as to accumulate flood waters therein until they may be released with safety, though by doing so, lands around the lake may be inundated.

Provision is made for flowage rights by these engineers in the estimate of costs.

The government engineers consider this project practical and feasible. They say that 112,370 acres of land—Minnesota 31,140 acres; North Dakota 75,160 acres; South Dakota 6,070 acres, would be directly benefited. Assessing the cost, $1,400,000 against the 112,370 acers would amount to an assessment of $12.50 per acre. The cost, although large, they say is very reasonable when the value of the land as it now is and as it will be when drained, is taken into consideration. (Bulletin, pp. 71, 72).

All of the engineers in this case are of opinion that this project is practical from a construction point of view, and that it would, if installed, entirely do away with floods in the Bois de Sioux valley; but they do not recommend it at this time. The views of the engineers are similar. We here set forth the testimony of Mr. Morgan on the subject:

> "Q. Have you given the plan suggested by Bulletin No. 1017 sufficient study to enable you to say whether or not it is feasible from an engineering standpoint?
>
> A. From a construction point of view it is entirely feasible. It would accomplish the results expected of it.
>
> Q. In other words, in your opinion, the project if carried out would do away with flood conditions in the Bois de Sioux valley?
>
> A. Yes.
>
> Q. Do you consider it advisable or necessary to carry through a project of this magni-

tude at this time in order to relieve the lands in the Bois de Sioux valley from flood?

A. I believe it would be inadvisable to carry through that project as outlined.

Q. Will you state briefly your reasons for that?

A. The degree to which flood protection can be carried depends largely upon the interests at stake, upon the value of lands and upon the desire for relief. I believe that to carry through the entire project as outlined in Bulletin 1017 would put an unduly heavy burden upon the lands affected and would not be an economically sound undertaking at the present time because the returns from the reclaimed lands would not justify so great an expense.

Q. This bulletin has reference to improvements in the Red River valley nearly to the Canadian boundary line, has it not?

A. Yes, sir. I was referring, however, only to the part that relates to the Bois de Sioux River.

Q. Have you given the bulletin sufficient consideration to be able to state whether or not the project suggested for the Bois de Sioux valley may be considered and carried out independent of the projects suggested for the balance of the watershed?

A. Yes, it can be carried through entirely independent of the larger project.

Q. And if carried through it will not have a detrimental effect upon the lands to the north of the point at which the project is supposed to end?

A. I believe not. I am not able to say how the balance would be. In some cases, it would be decidedly beneficial to the lands above.

There might be some cases in which the balance would be the other way, but it is so slight as not to affect the situation practically." (Add. Rec. p. 74).

See Meyer, add. rec. pp. 35 and 36; Chandler, add. rec. p. 27.

Dean Shenehon, at the time of the hearing, knew of the existence of Bulletin 1017, but had given it no study; and this, in view of the fact that the report was one going exhaustively into the flood situation in the Bois de Sioux valley (Add. rec. p. 15).

VI.

North Dakota's Project Involves a Shift of Position Rendering Unwarranted the Granting of Equitable Relief.

In the bill of complaint it is alleged that certain lands in the Bois de Sioux valley were flooded in 1915 and 1916, resulting in their damage and a total loss of crops thereon. (These lands are shaded yellow on complainant's exhibit A, Original Rec., I, p. 16). It is further alleged that the overflow of these lands and all thereof for each of the years was caused solely by reason of the construction of the Mustinka Ditch. The loss of crops for the two successive years is attributable, of course, to the same cause. The position, as set out in the bill of complaint, then, is that the floods of 1915 and 1916 were caused by Minnesota's drainage system; and it is there asserted that Minnesota should

pay for the loss of crops and damage done to lands over the entire area inundated; and to prevent a repetition of the trespass, that she should have relief by way of a mandatory injunction, whereby Minnesota should be required to close and abate the Musinka Ditch and the outlet thereof, and refrain from using the ditch and outlet for draining the waters of the Mustinka River watershed into Lake Traverse.

This was the position taken at the original hearing by complainant's engineering experts; they testified that the floods of 1915 and 1916 were caused by Minnesota's drainage system.

On direct examination Dean Shenehon testified:

"Q. It has been testified to in this case, in substance, that in the late fall of 1914, and by the late fall I mean a period after—as the witnesses described it—the fall plowing had been completed, the Bois de Sioux river increased its stage in the valley here with which we are dealing, inundating its banks to some extent; that in 1915 the Bois de Sioux commenced to raise along in May, and by June assumed what is described by the witnesses as flood conditions, continuing to raise until about the 20th of July, at which time there was overflooded substantially the area indicated in yellow on complainant's exhibit 1; that these flood waters in the year 1915 receded in the late fall to a point where approximately fifty per cent of the flooded area or thereabouts was uncovered, although left wet, and the remainder left inundated and froze up during that fall; that in 1916 in the

spring a little earlier the Bois de Sioux again began to raise, and in the summer months reached a higher stage than in the previous year of 1915; overflowing the area marked in yellow on complainant's exhibit 1 in the states of North Dakota and South Dakota, that area bordering on Lake Traverse and the Bois de Sioux river, and that these waters remained overflowing the land until comparatively late in the fall of that year. Assuming the facts as you have observed them and testified to yourself, and assuming the facts to have been as I have already described the testimony, are you able to express an opinion as to the cause of that overflow?

A. Yes.

Q. What, in your opinion, was the cause of that overflow?

A. The ditching operations of the State of Minnesota.

Q. That have been described in this case?

A. Yes.

Q. That is the Mustinka state ditch, as we have termed it?

A. The Mustinka State Ditch and the various constructions leading to it and from it. I must include the whole system, because the Mustinka river itself between Traverse and the Basin itself must be included." (Original Rec., I, pp. 463 and 464).

Mr. Boutelle, interrogating the Dean further regarding the cause of the floods, asked:

"Q. And, what would your opinion be?"

and the Dean's answer was:

"A. Just the same as I have stated, where the reference to the map was made, that the

ditching operations in the area involved is the cause of these floods of 1915 and 1916." (Original Rec. I, p. 465).

It is to be noted that the Dean's position at the original hearing was somewhat shifty; and it is difficult to entirely satisfy one's self as to his exact stand. As disclosed by portions of his testimony just quoted he took the position that the floods in question were caused by Minnesota's ditches. But at pages 469, 472, 475 and 491 of Volume I of the original record we find statements made by him which would lead one to think that he entertained some doubt as to the soundness of this position. He seems to have had in mind then what he now concedes, namely, that the floods in question were due in part to natural causes and in part to artificial drainage. But towards the close of the original hearing he again took his original position. At page 2075 of Volume IV of the original record is found this testimony by the Dean with reference to the cause of the floods of 1915 and 1916:

"I am afraid I don't quite follow you, Mr. Palmer, I think my answers have been very clear. I have repeated it a number of times and I did also in my original testimony that the artificial constructions in the State of Minnesota account for the floods in Lake Traverse and the Bois de Sioux valley."

As to the cause of these floods Professor Chandler testified as follows:

"Q. * * * Now, assuming that state of facts to be as I have stated and the conditions

as you have observed them and have testified here on the stand, are you able to form an opinion as to the cause of the overflow conditions in the fall of 1914 and the succeeding years of 1915 and 1916? Answer yes or no.

A. Yes.

Q. Professor, to avoid any confusion, the area to which I have referred as being overflowed in the state of North Dakota and to which you were referring in answer to my question is the area shaded in yellow on complainant's exhibit 1 in the valley of the river which is the outlet of Lake Traverse, whether that river be called by the witnesses the Bois de Sioux or the Red River of the North.

A. Yes, sir.

Q. What is your opinion on that subject?

A. My opinion is that the flooding of the lands resulted from the construction of the original state ditch and the extension in 1911 which afforded it an outlet and the rectification of the river channel which improved the outlet.

Q. In order that we may not inject any confusion into the record, what do you mean by the rectification of the river channel?

A. The dredging, enlargement and straightening of the river channel from the lower end of what has been termed the cutoff to Lake Traverse.

Q. In other words, you refer to the Mustinka state ditch?

A. Yes, sir, the Mustinka state ditch.

Q. And by the ditch construction which you refer to in your answer, you refer to the ditching in this general area that you have de-

scribed at the confluence which you observed on the ground?

A. Yes, sir." (Original Rec., I, pp. 519 520).

Q. From that you would draw the inference that the excessive rainfall in 1915 and 1916 does not account for the flooding of lands in the Bois de Sioux valley, and you account for it by this ditch construction.

A. Yes, sir." (Original Rec., I, p. 526).

In addition to the foregoing direct testimony of Dean Shenehon and Professor Chandler as to the cause of the floods we find disclosed in volume I of the original record at pages 463, 464, 524 and 525, testimony by these experts that there was nothing in meteorological conditions to account for these floods.

The brief filed by North Dakota in December, 1920, is based on this position. This is evident from a reading thereof.

We call particular attention to the following, taken from this brief:

"Tenth: That the floods in question were caused by the excessive runoff of the waters of the Mustinka watershed, resulting from the artificial construction in Minnesota. That under substantially similar conditions there would inevitably be repetitions of such floods as long as this artificial system was continued. That the same or even more favorable precedent conditions must be naturally expected in the future, and that floods of even greater extent and of longer duration in the Bois de

Sioux valley would necessarily follow" (Brief, pp. 22, 23).

"Sixth: That the flooding of the Bois de Sioux Valley was therefore ascribable to the drainage by Minnesota of naturally accumulated surface waters within its limits into the natural (interstate) discharging channels with the result of overtaxing and surcharging the capacity of these channels" (Brief, p. 80).

That such was the position taken in this brief is further shown by the fact that claims for damages for loss of crops and injury to lands throughout the whole area alleged to have been flooded were asserted on pages 138 and 142, inclusive, thereof.

This position has been abandoned. This is shown by the direct examination of North Dakota's experts with reference to their proposed project for flood relief in the Bois de Sioux valley.

We quote from a portion of the direct examination of Dean Shenehon:

"Q. Now, returning to the particular Lake Traverse area with which we are dealing here, Dean Shenehon, and so that we will understand one another and to what my questions addressed themselves, are the matters to which you have already referred, from your standpoint matters of what we ordinarily term flood control?

A. Yes.

Q. What is the objective point to which you have directed your studies in this case?

A. To caring for the excess water alone which comes down the Mustinka River, so that

Lake Traverse itself and the Bois de Sioux River downstream from Lake Traverse and the Red River of the North, will have no superburden.

Q. Then, so that we will be absolutely clear, are the projects to which you have referred, Dean, and with respect to which I shall ask you in more detail later on, aimed at embracing or protecting the entire flood conditions that might arise or merely the excess that you figure or estimate is due to the Minnesota drainage system?

A. No, I have attacked the problem on the theory that the floods which will exist in the Bois de Sioux River after the construction of such works and the floods which exist in Lake Traverse after the construction of such works will be such as obtain in a state of nature, that the excess alone is being taken off.

Q. And by the excess, as I understand, you mean such excess as you assume or consider has been produced as the result of the ditching in Minnesota?

A. That is true." (Add. rec. p. 6).

On cross-examination, the Dean testified as follows:

"Q. Is this project that you suggest contemplated to protect the Dakota lands from such floods as occurred in 1915 and 1916?

A. North Dakota lands?

Q. Yes.

A. To the extent that that flood was caused by excess." (Add. rec. p. 18.)

When confronted, on cross-examination, with the question whether he had testified at the orig-

inal hearing that there was nothing in the meteorological conditions in the years 1915 and 1916 to cause the floods complained of in the Bois de Sioux valley occurring during those years, he answered in this way:

> "As I remember,—whatever I said is indicated in the record and I have not gone over the record; I will give you certain recollections. *I have a very distinct memory, however, of stating that in the absence of the ditching there would have been a decided flood in Lake Traverse and the Bois de Sioux during April, 1916.* So I think without going into the record I can reiterate that statement, but I did not say there was nothing in the meteorological conditions that would indicate a flood. I said this particular flood was, as I told you this morning, on Lake Traverse, six to ten inches above what it would be in the absence of ditching, and I do not remember the amount on the Bois de Sioux in the vicinity of Fairmont." (Add. rec. p. 16).

It is to be noted in connection with this testimony that the Dean's memory as to his former testimony was faulty. He did not testify that there would have been a decided flood in April, 1916, in the absence of the ditches. With reference to meteorological conditions, we call attention to his testimony found on page 463, volume I of the original record, which was tersely summarized in complainant's original brief at page 44 in this way: "In my judgment, nothing is disclosed in the meteorological conditions of the years 1915 and 1916, to account for the floods in question."

From the foregoing, there can be no dispute as to the present position of North Dakota. It is not now claimed that all the flooding of each of the years 1915 and 1916, was caused by Minnesota's drainage system. It is now conceded that there would have been a decided flood in 1916 had there been no Mustinka ditch and branches; and that there will be decided flooding in the future, attributable solely to natural causes. The claim, in substance, is that there was flooding in 1915 and 1916 over and above that due to natural causes, and that there will be such flooding in the future, due to this system. This is referred to in complainant's supplemental brief as "the excess floods." The project proposed is offered to eliminate the possibility of this excess flooding.

The new position, to our minds, is a curious one to take. With the decided flooding which may be looked for in the future, North Dakota is not concerned. This may come in the future, as it has in the past; but North Dakota insists that the possibility of this excess flooding be eliminated, and that this be done by Minnesota, at a cost of $100,000. In other words, North Dakota, in effect, says, "We want this excess flooding taken care of, notwithstanding there will be decided flooding, though it is taken care of." Is it possible that North Dakota expects this court to make a decree ordering Minnesota to install a project at considerable cost when it is admitted that notwithstanding its installation, there will be decided floods in the Bois de Sioux valley? Is North Dakota en-

titled to any relief, in view of her attitude with reference to the construction of flood control works, from which the inevitable conclusion is that in her opinion the lands in question are not of sufficient moment to justify protection from flood conditions?

Is the new position sufficiently supported by the record to enable the court to make a decree based thereon? We submit that it is not. Our position is that this "excess flooding", about which North Dakota is now so vitally concerned, is, in the light of the testimony of her chief expert, so vague and indefinite as not to be susceptible of characterization or measurement.

This is clear from cross-examination of Dean Shenehon at the supplemental hearing. We quote therefrom:

> "Q. What I am trying to find out, Dean, is the extent of the damage you have in mind that will be remedied by this project that you suggested.
>
> A. Any damage that was established and testified to in the record, so far as North Dakota is concerned.
>
> Q. Now, take the year 1916, what portion of the floods which occurred in the Bois de Sioux valley during that year do you figure will be taken care of by this project that you suggest?
>
> A. See the record.
>
> Q. That is the only answer you can give?
>
> A. That is the only answer.
>
> Q. Is it a fact, Dean, that this project which you suggest is not expected by you to

take care of floods which might spread over the entire area marked yellow on complainant's Exhibit A?

A. You mean if a flood so much in excess as the flood of 1916 should come along?

Q. Similar to the flood of 1916?

A. No, we are not expecting to take care of but such portions as in a state of nature—

Q. What is that portion?

A. I don't know.

Q. You don't know what it is?

A. I might say to you that when you present a chart which is marked yellow—I rather think this was presented by Minnesota in the original case, I am not certain about that—we are presenting a remedy so that the state of nature is returned so far as the damage is concerned of any lands that were damaged in 1916, that you would have some flow in the Bois de Sioux River that would have occurred in a state of nature, and therefore, the lands that in that particular year were flooded would not be flooded. Now, if that line represents the demarcation of the flood of 1916—

Q. Is your memory so bad that you do not recall Exhibit A in this case?

A. I do not know whether it is Exhibit A or B or C. I remember that there was an exhibit of that kind.

Q. Look at it.

A. I do not want to reopen the case. I have not studied the case.

Q. I am not reopening the case, I am trying to get you to tell us what your project would do.

A. If I evolve a method, so far as North Dakota is concerned, of absorbing the water,

that is, the excess growing out of the ditching system of Minnesota, why do I need to go down to the Bois de Sioux River and talk about Dakota lands. This is the remedy we are talking about; that water would not go down there under the scheme or project I have in mind. You are opening the question of the danger, the Supreme Court has called for a remedy.

Q. The complaint in this case charges Minnesota with flooding the entire area marked yellow; they want damages for the loss of crops on that entire area, and the testimony taken before was based on that proposition.

A. Yes.

Q. Now, your testimony this morning indicates that you have not in mind what North Dakota had in mind originally at all, but you have something else, some strip along in there; is that the situation?

A. This is the situation. You have this excess coming from the ditching system and set down in the record in 1917 and 1918. That is the positive thing. Here is a negative thing which offsets that, that is, Lake Traverse. Now, when you reach the Bois de Sioux in North Dakota nothing remains. So far there is no damage. Is that clear?

Q. Take this territory marked yellow—

A. You understand I am talking about my project.

Q. Yes, I understand that. You take this territory, marked yellow on Exhibit A, territory claimed by North Dakota as having been flooded by reason of the ditch. Now, what portion of that territory will be protected by your project under conditions similar to those which occurred in 1916?

A. Any portion that is covered by the excess of the flood.

Q. What portion is that?

A. Well, see the record.

Q. Is it a strip extending westerly along this portion of North Dakota marked yellow on Exhibit A?

A. See the record on the matter of damages. I am giving remedies now.

Q. Can you answer that question, Dean?

A. No, I do not care to answer it.

Q. Is this project that you suggest contemplated to protect the Dakota lands from such floods as occurred in 1915 and 1916?

A. North Dakota lands?

Q. Yes.

A. To the extent that that flood was caused by excess.

Q. Now, what conditions did you have in mind when you framed this scheme for flood control as compared with the conditions in 1916?

A. I had in mind that when the flood of 1916 should come along Lake Traverse would be at a low level, 971 or 972. There is your receptacle, that would absorb the excess, so that any water spilled would be only the water that might have flowed in a state of nature without any ditching in Minnesota." (Add. Rec. pp. 17, 18).

It is to be noted that the Dean directed his questioner to go to the original record to find out about the excess flooding. This was a novel command in view of the fact that North Dakota's position at the original hearing was that all flooding com-

plained of was due to Minnesota's drainage system and that the testimony adduced on behalf of North Dakota at that hearing was in support of such position. Perhaps the Dean had in mind his own testimony heretofore referred to and found on pages 469, 472, 475 and 491 of Volume I of the original record. Let us examine this testimony and see whether the same throws any light on the situation.

At page 469 we find this testimony:

"A. I say we will have flood years, years of plentiful precipitation, and other conditions favoring run-off when the axiomatic effect of these ditchings in the state of Minnesota will be to make the flood higher than it would be in their absence.

Q. Well, then, in the average year, the years of normal precipitation, during the period that I have mentioned, there will be no flooding of these lands in the Bois de Sioux valley?

A. I have said that precipitation is only one of the elements. It is the dominant element. You have taken the months where there is an accumulation of snow and ice and condition of temperature at the break-up of winter have a great deal to do with flood conditions

Q. Don't you take those into consideration when you give this opinion?

A. Yes, whatever natural conditions exist with the new artificial constructions we will always have a higher flood than the flood that existed in the absence of these constructions in the state of Minnesota, and if we don't have

any flood we will have a little higher lake level normally in my judgment.

Q. Now, I asked you what other natural conditions you took into consideration in addition to the rainfall in figuring a recurrence of these floods—what other natural conditions will recur?

A. We have this one constant condition of water brought with a higher velocity. I took into consideration the fact that rainfall is the predominant influence, or precipitation—when I say rainfall I mean snowfall as well; temperature conditions, a sudden breakup, all the causes that tend to make floods. Those are the natural ones.

Q. Are there any other natural causes that tend to make floods?

A. A great many."

At page 472 this testimony:

"A. The construction of the ditch doesn't entirely set aside those variations in temperature that God Almighty imposes.

Q. That is true, then, isn't it?

A. It has one artificial condition that is superimposed on these complex natural conditions.

Q. Then the construction of the ditch doesn't accelerate the flow of the waters in the spring time unless the conditions are particularly favorable to it?

A. We must consider then two conditions; one, this area of watershed in a state of nature, and then the watershed under artificial condition, with identical conditions. Unquestionably we will get more water in the later case."

At pages 474 and 475 this testimony:

"Q. What is your judgment founded on for a recurrence of this flood?

A. That natural causes will remain the same and new artificial conditions that tend to create floods have been created.

Q. And will continue to be created?

A. And will continue to be created.

Q. With artificial conditions now created, irrespective of those which you took into consideration which will continue to be created as you say in the future, and Lake Traverse at a state of 975, I will say, and a precipitation during the period I have mentioned of twenty-one per cent. less than in 1916, will these floods recur in the Bois de Sioux valley in your opinion?

A. I don't know. The complex of things causing run-off is so intricate that I cannot answer the question.

Q. Then the complex conditions entering into the matter of run-off make it difficult to form any reliable opinion as to the recurrence of these floods in the Bois de Sioux valley?

A. No, that is not so.

Q. Why?

A. Because we have super-imposed on these complex natural conditions this one artificial influence that engineers all know tends to create floods—the removal of a detaining basin and the impairment of a second one.

Q. That is all the answer you can make to that question, Dean Shenehon, is it?

A. That is the answer I have made, Mr. Palmer. I will be glad to answer further, if you will elaborate."

And at page 491 the following testimony:

> "A. I mean that while the various natural elements which combine in a great variety to cause run-off on floods, forming a complex, as I have used it, render it difficult to forecast a flood, nevertheless, a certain modification of the watershed had been brought about, the inevitable and axiomatic effect of which must be to accentuate and increase the level of the flood."

It would seem from this testimony that the Dean was fairly well convinced that the floods complained of had been caused partly by natural conditions and partly by reason of Minnesota's drainage system. There is nothing in this testimony, however, from which we can measure the portion of the flooding in question attributable to natural causes and the portion attributable to artificial conditions; and as heretofore pointed out, the Dean, toward the close of the original hearing, clearly reverted to his original position that the floods were solely caused by the ditches. We have examined the rest of the testimony of the Dean and the testimony of North Dakota's other engineering experts and find nothing throwing any light on the subject. In fact this matter of excess flooding was in no way gone into at the original hearing except as pointed out. All North Dakota's testimony relative to precipitation, run-off and lake levels was in support of the original contention. Are we now to take this testimony explanatory, according to North Dakota, of all the flooding com-

plained of, and attempt to figure out from it what part of such flooding was due to natural causes and what part to artificial causes?

North Dakota in its supplemental brief did not undertake to do this; it proceeded on assumptions. At pages 13 and 14 of the brief we find this:

> "In other words, assuming that the excess flood flow, due to artificial causes, has been determined with reasonable accuracy and that the resultant effects, so far as the lands in the Bois de Sioux valley are concerned, have been similarly ascertained, the project as proposed by the experts of complainant has aimed at safeguarding a repetition of these conditions, with reasonable allowances for varying natural phenomena as factors of safety. (Shenehon, record, page 6, 7)."

We take it that North Dakota saw fit to proceed on assumptions of this kind for the obvious reason that the evidence in the record adduced in its behalf is such that the character and extent of these so-called "excess floods" cannot be ascertained; the evidence was put in for another purpose, and cannot very well be juggled around to fit the new situation.

As heretofore stated, North Dakota now concedes that there would have been a decided flood in 1916 in the absence of ditches. We are left in the dark as to the extent thereof, and as to the extent of the excess flooding which occurred during that year attributable, according to North Dakota, to Minnesota's ditches. North Dakota contends that

the ditches caused excess flooding during that year, and that they will cause such flooding in the future. It, in effect, says: "We do not know what the excess flooding was in 1916, nor what it is likely to be in the future." According to North Dakota, the extent of this excess flooding is wholly immaterial. We insist that it is highly material in this case. Under North Dakota's original position, the court would have, if it reached the same conclusion as North Dakota as to the cause of the floods of 1915 and 1916, something tangible on which to base a decree for equitable relief. The flooding due to ditches was under this original position definite as to character and extent. What is the situation now? Is the court able, in view of the new position, to determine just what the injury is that North Dakota is now complaining of? We say no. There is nothing before it from which it can determine with any degree of accuracy whether injury in serious magnitude was done to North Dakota in 1915 and 1916, and is likely to be done in the future, by reason of Minnesota's ditches. It is incumbent upon North Dakota, before it is entitled to equitable relief, to prove that injury is threatened, and to show the exact character and extent thereof, so that the court may determine whether the injury is of sufficient magnitude to justify the exercise of its extraordinary power. This it has wholly failed to do, and as a consequence, is not entitled to any relief in this case.

VII.

HOW SHOULD THE EXPENSE OF A PROJECT DEEMED FEASIBLE BE APPORTIONED, TAKING INTO ACCOUNT DISCHARGES OF WATER BY CERTAIN STATES AND THE BENEFITS CONFERRED?

1. *North Dakota's position.*

North Dakota devoted no attention at the hearing to the second subject upon which the court directed testimony be taken. It took the position that its project will do away with "excess floods" which it claims will occur by reason of Minnesota ditches. In view of this position, North Dakota insists that Minnesota should pay the entire cost of the project it proposes.

We have heretofore discussed the testimony given by North Dakota's experts at the original hearing which we assume is looked upon as supporting the contention that the ditching system will cause "excess floods" in the future, such as it is now claimed were caused in the years 1915 and 1916. Let us now give attention to the assertions made in complainant's supplemental brief, in the light of additional testimony and the information contained in Bulletin 1017, in support of this new contention. In doing this, some references will have to be made, of course, to testimony offered at the original hearing.

(1) *Complainant's assertion that meteorological data offer no explanation of the floods of* 1915 *and* 1916 *is without the slightest foundation.*

On page 73, supplemental brief, complainant states:

> "It is significant that in all of the variety of theories now advanced by Minnesota's experts, reinforced by tabulated data and computations, no explanation for the floods themselves has been vouchsafed."

And again:

> "* * * the silence of these witnesses with respect to the 1915 flood is one of the most conspicuous features of the case."

Complainant then proceeds to say, on page 74:

> "The natural conditions of 1915 disclose nothing abnormal. The annual precipitation of that year was below normal and amounted to 23.06 inches."

And further:

> "* * * the aggregate precipitation for these months, (speaking of May, June and July), in 1915, was less than the similar aggregate for the years 1882 and 1905. * * *"

The intent is clearly to befog and confuse. The meteorological data cited have no bearing on the meteorological causes of the flood. Neither the aggregate precipitation for a year, nor the aggregate precipitation for three months constitute the significant meteorological fact. Complainant's

own witness, Professor Chandler, testified as follows, on page 522 of volume I of the original record:

> "Q. Having regard to the physical conditions, the conditions of topography in the area with which we are dealing, what, with respect to the time of precipitation would you look for as productive of a flood condition?
>
> A. From ten days to a month."

Minnesota's experts devoted no time at the supplemental hearing to discussing the meteorological causes of the Bois de Sioux floods because these were fully established by the original record and corroborated by government Bulletin 1017, from which complainant has voluminously quoted with approval.

Having in mind now that the precipitation productive of summer floods, as testified to by Professor Chandler, is that which falls within a few days to a month, the cause of the 1915 flood can readily be ascertained. On page 523, volume I of the original record, Professor Chandler states that the precipitation during June, 1915, was 7.4 inches. In table 6, page 25 of the government Bulletin 1017, the precipitation over the entire Red River watershed for June, 1915, is given as 7.56 inches—the maximum amount for any one of the 456 months for which records are given in that table.

Relative to the floods of 1914, Professor Chandler testified on page 523, volume I of the original record, that during June, 1914, 10.4 inches of rain fell on the Mustinka watershed.

The summer floods of 1916 were also due to excessive precipitation, following a spring of most extraordinary flood due to heavy winter and early spring precipitation. According to table 9, page 32 of Bulletin 1017, which gives data for thirteen great rain storms which have occurred in the Red River watershed, 3.84 inches of rain fell in three days, on June 28-30, in a storm which centered at Beardsley, Minnesota, near the southern edge of the Lake Traverse watershed. The summer flood of 1916, on the Mustinka River, crested at Wheaton about a week after this extraordinary rain storm.

In the face of these records of extraordinary precipitation, complainant's contentions are indeed astounding. Complainant on page 77 of its supplemental brief states:

> "The detailed examination in the report of storm distribution has already been referred to and is mainly important as confirming the general statements of complainant's witnesses, of the effects attributable to such storms on flood conditions. As applied to the matters here in issue, these features have no other than general bearing for the reason that *upon the facts here presented, we have no occasion for dealing with storms of abnormal proportions.*" (Italics ours.)

And again on page 81, complainant states:

> "It will be recalled that as applied to the particular watershed in question, no records exist of abnormal storms which have reflected themselves in the volume of run-off."

Although the Mustinka watershed constitutes only one-fiftieth of the entire basin of the Red River in the United States, yet two out of the thirteen storms listed in table 9, page 32, Bulletin 1017, centered right on the edge of this watershed. And yet complainant states that, "no records exist of abnormal storms which have reflected themselves in the volume of run-off!"

Further illustrations of inaccurate interpretation of data are disclosed by the following statements found respectively at pages 78 and 79-80 of its supplemental brief:

> "In table 3, page 20, the authors tabulate the maximum stream discharges throughout the entire watershed. This table properly understood is similarly corroborative of complainant's experts."
>
> "The Thief River shows approximately four second feet on April 23rd, 1916. This phonomena, however, is explained in table 9, p. 32, disclosing one of the great storms in its area during the four previous days in which was concentrated a precipitation of practically three inches."

The facts are these:

First, the maximum precipitation at the center of the storm, according to the table referred to, was 2.58 inches, instead of "practically three inches."

Second, the storm center was at Campbell, Minnesota, according to column 5 of the table referred

to. This weather bureau station is only about fifteen miles from the Mustinka River, and more than one hundred miles from the nearest point on the Thief River watershed! Instead of this storm —upon which counsel for complainant has unintentionally permitted attention to be focused— having been the cause of the Thief River flood of April 23, 1916, this storm helped to prolong the flood conditions on the Mustinka and the Bois de Sioux created by the excessive precipitation of the winter of 1915-16.

The primary cause of spring floods is heavy winter and early spring precipitation. The explanation for the April, 1916, flood in the Bois de Sioux River is as clearly found in the meteorological data as is the cause for the summer floods of 1914, 1915 and 1916. On cross-examination, (page 467, I, original rec), Dean Shenehon admitted that the precipitation from November, 1915, to April, 1916, inclusive, was 48 per cent above normal. On cross-examination, (add. rec., pp. 15 and 16), the same witness admitted that there would have been a decided flood in April, 1916, even in the absence of the ditches. Government Bulletin 1017, table 6, shows that the precipitation in the Red River watershed from November to April, inclusive, was higher in the winter and spring of 1915 to 1916, than in any other winter and spring from 1882 to 1919, except 1897, when the greatest flood on record occurred in the Red River valley.

The authors of Bulletin 1017 state, on page 26:

> "The precipitation on large portions of the watershed during the first six months of 1916, and during the last six months of 1909, was considerably above normal and caused excessive run-off."

As the flood conditions of 1916 extended throughout most of the year, it is significant to note that according to Bulletin 1017, the precipitation for 1916 was greater than for any other one of the 38 years for which records are given in table 6.

More significant than this fact even are the data given in table 7 of this Bulletin. The entire watershed above Grand Forks is divided into seven subdivisions in this table. Of these, the Mustinka-Lake Traverse-Bois de Sioux and the Ottertail basins constitute subdivision No. 1. The North Dakota Wild Rice River constitutes subdivision No. 2. Table 7 shows that the 1916 precipitation was the maximum recorded on subdivision No. 1, and the maximum recorded for the entire watershed above Grand Forks. The maximum for the remaining subdivisions occurred as follows: No. 2 in 1906; No. 3 in 1905; Nos. 4 and 5 in 1896 This shows that the precipitation over the Mustinka-Lake Taverse-Bois de Sioux watershed in 1916 was so much greater than the precipitation for all the remaining years as to overbalance, in determining the average, the lower precipitation on the remaining four watershed sub-divisions, and thus to bring the average for the entire water-

shed above Grand Forks higher than that for any other year.

The floods in other portions of the Red River watershed were concededly due to excessive precipitation. The precipitation on the Mustinka-Lake Traverse-Bois de Sioux watershed in 1916 was greater than that on other portions of the Red River watershed. On what ground, then, can complainant assert that there is nothing in the meteorological data of 1916 to account for the floods in the Bois de Sioux valley?

(2) *The assertion that the Minnesota ditches have doubled the run-off is based upon a misinterpretation of records.*

Complainant's endeavor to conceal the meteorological causes of the Bois de Sioux floods by citing inapplicable data finds a parallel in complainant's endeavor to show that the Minnesota ditching has doubled the run-off from the Mustinka watershed.

On page 76, complainant's supplemental brief, this statement is made:

> "Briefly digressing at this point, attention may be directed to the fact that the run-off from the Mustinka watershed for the year June, 1916, to June, 1917, after the ditching construction was completed, as recorded at the Wheaton station, was 207 second feet (original record, p. 546), which, for the 750 square miles of watershed area, would show .27 cubic feet per mile, or, considerably more than

double the mesne as determined by the authors of the bulletin."

"This showing clearly confirms the statement of complainant's experts to the effect that the volume of discharge from this watershed has been substantially doubled as a result of the ditching. Under flood conditions, the excess might reasonably be expected to manifest a still greater proportion to the natural discharge, but this feature need not be further emphasized."

The comparison here made is the total run-off from the Mustinka watershed of 750 square miles, in a *wet year*, with the *average* run-off from the Red River watershed of 26,000 square miles during the entire period of 38 years. What purpose can such citations serve but to becloud the issue? The bulletin referred to shows that the run-off from the Red River watershed during 1916 was more than twice the average for the entire period of 38 years.

More applicable still are the data given in Minnesota's exhibit A-2 (Add. rec., p. 106). Whereas the total run-off from the Mustinka watershed for the entire period from 1916 to 1922 for which U. S. Geological Survey records are available, aggregated 5.0 inches depth on each square mile of area, the run-off from the entire Red River watershed above Fargo, of which the Mustinka is a small part and the Dakota Wild Rice River is a large part, aggregated 6.50 inches depth for exactly the same period of time. In other words, these government records clearly show that each square

mile of undrained area in Dakota contributed more water than a square mile of ditched area in the Mustinka watershed. This fact becomes still more significant when attention is called to the fact that the average rainfall over the Mustinka area is given as substantially 24 inches in Bulletin 1017, and only 22 inches over the Dakota Wild Rice River area.

We quote from the testimony of Professor Meyer, relative to the effect of ditches on the run-off from the Mustinka watershed:

> "From that situation, what conclusion do you draw with reference to the run-off of the Mustinka, that is, as to whether it is greater by reason of the existence of the ditches than it would be in a state of nature?"
>
> "A. In my judgment, there is nothing in the records to indicate that the run-off is any greater than it would be if there were no ditches, and in my judgment the run-off would not be substantially greater considering the character of the watershed and all factors that influence run-off. I would not expect to find any material change in the amount of run-off from that watershed as the result of the construction of drainage ditches in the so-called Delta Zone and other portions of the watershed." (Add. Rec. pp. 50, 51).

We quote also from the testimony of Mr. Morgan:

> "Q. My question was limited at this time to this, whether or not the Mustinka Ditch and ditches constructed in connection therewith

in the Mustinka watershed have increased the run-off from that watershed over and above the run-off which would take place in a state of nature?

A. If the Mustinka ditches have increased such run-off to any extent whatever then the increase was to such a very minor extent that that increase is a totally negligible element in the flood situation." (Add. Rec. p. 79).

The government data presented confirms the testimony of Minnesota's experts and proves conclusively that *Minnesota's ditching operations on the Mustinka watershed have not increased the amount of water contributed to the Bois de Sioux River.*

(3) *The delta zone never was a detaining basin.*

Complainant's case rests mainly on the assumption that there was a large detaining basin on the Mustinka River watershed on the area known as the Delta Zone, and that Minnesota's ditching operations drained and destroyed this natural retarding basin and cast the drainage waters into Lake Traverse in such volume and with such rapidity as to overtax the capacity of that lake and thus inundate large areas of land along the Bois de Sioux River.

The testimony at both hearings clearly shows that the delta zone never was a detaining basin. The testimony taken at the original hearing was thoroughly discussed in our former brief.

We quote from the testimony of Professor Meyer found in the additional record.

At page 33:

"Q. Have you considered the matter of constructing a detaining basin in the so-called Delta Zone?

A. I have given some consideration to that also.

Q. Will you state just what consideration you have given to that phase of the matter?

A. In my judgment there is no satisfactory site for a detaining basin within the Delta Zone because of the gradual slope of the land throughout that area. There is nowhere a sufficiently cupped shape or natural site to furnish a satisfactory detaining basin within that zone."

On the question whether the Delta Zone ever was a detaining basin, Mr. Morgan, at pages 80 and 81 of the additional record, testified as follows:

"A. Lake Traverse itself is a true retarding basin. It is surrounded by higher land, with only the inadequate channel of the Bois de Sioux River as an outlet. It is not entirely surrounded by a high rim but surrounded about 95 or 98 per cent by such a rim, possibly 95 per cent surrounded by such a rim, and in the area not so surrounded the land is so very flat as to not furnish an outlet. The Delta Zone of the Mustinka River, on the other hand, is an entirely different formation or has entirely different formation. An examination of Complainant's Exhibit A in the original

case shows this fact very distinctly. The contour lines across the territory which it is claimed is a retarding basin run in fairly nearly straight lines. That is, it is a fairly curved slope, with nothing whatever in the nature of a rim around it, absolutely nothing in the nature of a rim around it.

It is a sloping prairie with a fall of about five feet to the mile. That fall is greater than the general slope, surface slope, over, say, half of the farm land of Illinois. It is a greater surface slope than exists almost anywhere in the rich farm lands of Arkansas, Missouri, or Mississippi. It is a slope which in general would be adequate for drainage. The difference between this territory with a slope of five feet to the mile and Illinois and Ohio farm lands with the same slope is that this land in the moraine zone is fairly uniform. It has not the little local variations of small ridges and hollows.

Mr. Brown:

Q. You mean the moraine zone?

A. The Delta Zone, pardon me. The surface of this Delta Zone has a general pitch of five feet to the mile but is lacking in many of the little surface irregularities of a foot or more which are common in Illinois and other rich agricultural regions. So that, while the water travels across that country, it does so without gathering so much into little brooks and rivulets as it does in some territories. It is not in any sense whatever a retarding basin. The water on its surface is purely surface water. Mr. Shenehon testified in the former case that the water over that so-called retarding basin would be from 1/6 of an inch to

two or three inches deep. A depth of water from 1/6 of an inch to two or three inches deep is purely surface water. That difference or variation may occur in almost any flat place, the little irregularities of almost any farm surface would be as great as that.

If that statement is correct as to the depth of that water then it could not have backed up more than—if there was any place where there was a rim the water would not have backed up back of that rim more than two or three feet to five feet deep. In fact, it has none of the characteristics of a retarding basin but it has all the characteristics of sloping, flat, prairie land. I could find no evidence, either on the ground or in the testimony, which indicates that this ever was a retarding basin."

The Delta Zone is only a small portion of the Mustinka watershed, and the evidence shows that at no point in the Delta Zone was more than an inch or two depth of water stored. The cut-off ditches constructed in the Delta Zone could not carry away water any faster than it was brought in from the large tributary watershed. The size of the natural channel of the Mustinka River in the Delta Zone is no measure of the volume of water carried into Lake Traverse in time of flood, because the testimony clearly shows that the river left its banks and the flood water swept across the adjacent lands in tremendous volume, ruining the crops in the Delta Zone.

The farmers living in the Delta Zone testified that because of unprecedented, long-continued

rains, they lost practically all of their crops during 1915 and 1916. (II-966; II-735; II-754; II-1107-8; II-1083; I-1140).

The testimony shows (additional rec. defendant's exhibit A-4, and pages 46 and 98) that even in the spring of 1922 the Mustinka River channel and the cut-off ditches were insufficient to carry away the flood water as rapidly as it was brought down from the tributary watershed and flooded the adjacent lands. The lands adjoining the Bois de Sioux River, on the other hand, were not flooded in 1922.

The testimony also (original rec. p. 472) shows that during 1917 the lands in the Delta Zone were similarly flooded because of the insufficiency of the Mustinka River channel, and the cut-off ditches, even though there were no floods in the Bois de Sioux River valley.

On cross-examination (original rec. p. 2101) Professor Chandler admitted that the floods in the Delta Zone were caused by excessive precipitation:

> "Q. Now, it appears here in testimony that more water stood upon the land in the Delta Zone during the years 1915 and 1916 than ever stood there before to the knowledge of anyone living in that locality, Professor Chandler, how do you account for that?
>
> A. The cumulative excess rainfall for the years 1914, 1915 and 1916, I believe those are the dates that have been given in the defendants' exhibits was some sixteen inches or thereabouts; in other words, succession of wet seasons."

Drainage ditches are ordinarily designed to carry away run-off water at the rate of one-quarter inch depth in twenty-four hours. Compare this with rainfalls of two or three inches a day and the inadequacy of open ditch systems in excessive storm periods becomes apparent. It is a recognized fact among engineers that it is not economical to provide drainage systems of capacity sufficient to carry off the run-off from the maximum expected rainfall. One of the primary objects of ditching systems is to carry off the "tail end" of rain storms instead of permitting the water to collect in little pools and kill agricultural crops before it percolates or evaporates. (Meyer, add. rec. p. 42.)

Complainant has presented absolutely no run-off records to show that Minnesota's ditching operations in the Delta Zone have increased the volume of run-off into Lake Traverse or have increased the natural flooding along the Bois de Sioux River. The conclusions of complainant's experts are based exclusively on the assumption that the run-off from the drained area was increased about 50 per cent and that the ditches have greatly accelerated the flow of water into Lake Traverse. No specific data are presented to substantiate their assumptions or to show that there would have been flooding along the Bois de Sioux River, even if the assumptions had been correct.

2. *Minnesota's Position.*

Minnesota's experts, before expressing an opinion with respect to apportioning the expense of the project suggested by them, made a careful study, the purpose of which was to ascertain whether Minnesota's ditches have increased the volume of run-off from Mustinka watershed into Lake Traverse, and whether the flood flow into Lake Traverse has been accelerated.

(1) *Ditches have not materially increased the run-off.*

This was just discussed in connection with the contention of North Dakota that the run-off from Mustinka watershed has been doubled by reason of the ditches. It was there pointed out that the records of the United States Geological Survey disclose no increase in the run-off by reason of these ditches.

The reasons why the ditches have not increased the run-off from Mustinka watershed and a summary of some of the most important factors influencing run-off are so clearly stated by Professor Meyer that we quote in some detail from his testimony as set out in the additional record on pages 51 and 52:

> "Q. What are the conditions in the Mustinka watershed which lead you to the conclusion that the run-off with the ditches is no more than it would be in a state of nature?
>
> A. The Mustinka River drainage basin is a combination of a great variety of conditions

affecting run-off as to topography, state of cultivation and ditching. The portion which has been referred to as the Delta Zone is a gradually sloping tract with a fall of about five feet to the mile, with a considerable number of flowing wells scattered through it, indicating that the area is under pressure of water from underneath, which in a state of nature undoubtedly helped to keep water near the ground surface, except as it was being evaporated during drier years. The soil, on the whole, is rather heavy. Under present conditions it is quite thoroughly cultivated throughout the Delta Zone. A large amount of fall plowing is done. Other portions of the watershed are naturally relatively slow. Those in the moraine zone, while the territory itself as to topography is rather rough, hilly, there are hills and between the hills there are depressions, swales, marshes, ponds and lakes which very materially retard the run-off from that section of the drainage area. In fact, I consider the moraine zone as being, on the whole, somewhat similar to large portions of the Otter Tail Watershed lying directly north of this moraine zone. I consider that, as a whole, a relatively slow area; that an area such as—

Q. What is there about such an area that makes it slow?

A. The water runs off from the hills themselves rather rapidly into the ponds and marshes and is detained as it flows from one pond and marsh to another, which acts as a small detaining basin and must be raised somewhat before the outflow is increased. So that, in its course from the edge of the water-

shed, for example, to the main stream, the particle of water is frequently retarded very seriously in its flow, even though it runs off rapidly from the initial hillside on which it falls. In the case of the Delta Zone, which slopes gradually, the channels themselves well indicate by their size that in times of flood tremendously large volumes of water were carried away by them. Comparing Twelve Mile Creek, for example, with the upper Mustinka, we find that the upper Mustinka is a relatively small stream compared with Twelve Mile Creek. In my judgment the lower portion of the drainage area, except for certain tracts around the headquarters of the tributaries, really are relatively fast rather than slow under natural conditions. This, coupled, with the fact of the flowing wells and the pressure of the ground water from underneath, had a tendency, combined with the heavy precipitation in times of protracted rains, for example, to create a surface condition which resulted in relatively heavy run-off. The effect of the drainage ditches has been to lower the water content in the upper several feet of soil and therefore increase its ability to absorb water. During excessively heavy concentrated rains the ditches undoubtedly gathered water and carried it away faster, as indicated this morning, to the extent of from a fraction of a day to a day, and carried off, so to say, the tail end of the water more rapidly than would be indicated by the rate at which the flood crest is reached. In that way there are conditions where the drains themselves in the case of freshets will carry down more water, but that, in my judgment, is counterbalanced

by the other condition which I indicated where under natural conditions that ground was in a better condition to shed water than it is under the present cultivated condition.

Now the total amount of water is made up primarily of flood run-off. The low water flow from a watershed of this character is relatively a small portion of the total run-off. Considering then, those two primary factors which go to make up the total run-off, it is my judgment that it is reasonable to find no indications in the records themselves of any increase in total run-off from the Mustinka River watershed as compared with other tributaries in the same drainage basin somewhat similar in character. I have also compared the upper Minnesota River run-off and in a similar way have found no outstanding difference one way or the other. The records on their face indicate more run-off from the remainder of the drainage basin above Fargo than from the Mustinka River drainage basin at Wheaton, but I do not attach a great deal of significance to that fact. Even after making due allowance for the flow of the Otter Tail River at Fergus Falls the fact remains that the records indicate approximately the same amount of total run-off, and in my judgment that is to be expected when all of the factors that influence run-off from that watershed are taken into consideration."

(2) *Ditches have not materially accelerated run-off.*

The records show that the flood flow into Lake Traverse has not been materially accelerated by the ditching operations.

Defendant's Exhibit A-3 (add. rec. p. 107) shows the dates on which the Mustinka River at Wheaton reached its highest stage and the date on which the Red River at Fargo reached its highest stage. Fargo, on the Red River of the North, is about 150 miles downstream from Lake Traverse. Moreover, the area of the ground from which the run-off waters are gathered into the Mustinka River at Wheaton is only 750 square miles in extent, whereas the total area draining into the Red River at Fargo amounts to over 6,000 square miles. It is apparent, on the face of this difference, that it takes less time to bring the flood waters from the small gathering ground into the channel at Wheaton than it does to bring the run-off waters from the larger gathering ground into the channel at Fargo. This Table shows a remarkable consistency in the difference between the dates on which the floods crested at Wheaton and at Fargo. The crest at Fargo was four days later in five instances, and three days later in one instance, for which government records are available on the two streams.

Mr. Meyer expressed it as his judgment that, on account of the difference in the size of the drain-

age areas, the river would crest at Fargo two or three days later than the Mustinka at Wheaton. For that reason, the ditching operations could not possibly have accelerated the flow of water into Lake Traverse by more than about a day, or a day and a half. The absurdity of complainant's contention that the ditching operations have brought the water to Lake Traverse six or eight days sooner is apparent.

Concentration of flood water due to acceleration of flow is best expressed in engineering terms in cubic feet per second per square mile. In other words, flood flow is expressed in the number of cubic feet of water contributed by each square mile of tributary drainage area, each second, to the total flow at the point of observation. It is a matter of common knowledge that large streams rise slowly and fall slowly and that small streams rise rapidly and fall rapidly. Other things being equal, a large stream signifies a large tributary drainage area and a small stream signifies a small tributary drainage area. The relation between watershed area and rate of flood flow is expressed on Page 39 of Bulletin 1017 in these terms: "The rate of run-off per unit area decreases as the size of the watershed increases." And again: "The relation of size of drainage area to rate of run-off per square mile for various areas in the Red River watershed is indicated in Table 5." Reference to this Table divulges the fact that streams having a tributary area of 500 to 1,000 square miles may be expected to experience flood flow rates of 3 to 7

cubic second feet per square mile. Streams having a tributary area of about 2,000 to 3,000 square miles may be expected to experience flood flow rates of only 1-1/2 or 2 cubic second feet per square mile.

The following Table, abstracted from Table 5, Bulletin 1017, clearly shows that the authors of this Bulletin do not expect higher rates of flood flow from the Mustinka River watershed than from any other watershed of approximately equal size in the Red River Basin:

From Table 5, Bulletin 1017.

Stream	Area of Drainage Basin in Square Miles	Estimated Future Floods Cubic Second Feet Per Square Mile	
		Summer	Winter
Mustinka River at Wheaton	756	4	4
Otter Tail River tributaries below Fergus Falls	540	4	4
Buffalo River at Georgetown	1175	5	5
*Minnesota Wild Rice River	835	7*	6
Clearwater River at Red Lake Falls	1330	5	5
Two Rivers at Hallock	635	4	4
Thief River at Thief River Falls	1080	5	4

*Although the estimated future flood on this stream is given as 7 c. s. f. per sq. mi., the flood of 1909, which probably represents a flood of magnitude recurring perhaps once in 100 years, showed a run-off of 11 c. s. f. per square mile.

Defendant's Exhibit A-4 (add. rec., p. 108) shows that the flood flow in cubic second feet per square mile from the North Dakota Wild Rice River and other tributaries of the Red, aggregating over 3,000 square miles, was almost as great in July, 1916, as that from the Mustinka River at Wheaton, with a drainage area of only 750 square miles. A similar condition is shown for the year 1922 in the lower half of defendant's Exhibit A-4, showing clearly that the rate at which the flood waters are being discharged into Lake Traverse *has not been materially accelerated by Minnesota's ditching operations.*

(3) *Rapid flood run-off and in-flow into Lake Traverse are not conducive to Bois de Sioux floods.*

Even if the ditching operations in the Mustinka watershed have possibly slightly accelerated the flood run-off into Lake Traverse, such acceleration has not been conducive to floods in the Bois de Sioux valley. Lake Traverse functions as a retarding basin. The flow in the inflow channels may be accelerated without the maximum level of the detaining basin being increased or the flow in the outflow channel being augmented.

This matter was fully presented by Mr. Meyer and Mr. Morgan.

The computations upon which their conclusions are based are not "hypothetical", not "arbitrary", not "theoretical." They are not "obsessions of the mathematical mind for the complex and the in-

comprehensible;" they involve no "indeterminate and arbitrarily assumed factor." On the other hand, the hypothetical questions asked by complainant's counsel, on cross-examination of Minnesota's experts, did involve just such factors and elements.

Mr. Meyer based his computations upon a rating curve of outflow from Lake Traverse (Exhibit A-5, add. rec., p. 109), which is entirely rational and in accord with the physical conditions of the outlet and the record in this case. He based his conclusions on a rate of inflow which is substantially in accord with the inflow claimed to have occurred in 1916, by complainant's own experts. Given the inflow into Lake Traverse and the relation between lake stage and outflow, it is a simple engineering computation to determine the resulting lake stage. The results of these computations are shown graphically in defendant's Exhibits A-6 and A-7 (add. rec., pp. 110, 111), and the computations are shown in Exhibit A-8 (add. rec., p. 112). These exhibits clearly show that if the ditching operations actually did accelerate the inflow into Lake Traverse in 1916, for example, the stage which the lake reached at the crest of the flood was actually lower than it would have been if the run-off waters had flowed into the lake more slowly. No radical, arbitrary assumptions of inflow have been made, or can reasonably be made, as a test of this principle. In a state of nature, the inflow into every lake gradually increases, reaches a maximum and then gradually decreases at a rate char-

acteristic of the tributary watershed. An examination of the hydrographs of flow of the Mustinka River and the Dakota Wild Rice River, defendant's Exhibit A-4, shows that the inflow curves, shown on defendant's Exhibit A-6, are as similar in shape to the actual observed conditions of flow on this watershed as it is possible to make them.

Defendant's Exhibit A-7 shows that the rate of outflow from Lake Traverse, under the condition of rapid inflow, is actually less than under the condition of slow inflow. Therefore, if the ditching operations of Minnesota have somewhat accelerated the flow of water into Lake Traverse, they have been beneficial to the lands bordering the Bois de Sioux River in North Dakota, and if, in apportioning the expense of any proposed project, any part of this expense were to be apportioned against the lands draining into Lake Traverse and the Bois de Sioux River, a larger charge per acre should be made against the lands of North and South Dakota than against those of Minnesota lying in the Mustinka River drainage basin.

Th detailed computations upon which Mr. Meyer's conclusions are based are shown in defendant's Exhibit A-8. The experts for Dakota offered no criticism of these computations, which is sufficient proof that they are correct and incontrovertible. There is nothing mysterious about these computations and the engineering principles upon which they are based—even though the conclusions are contrary to what those who have not made similar studies might expect. They are not "arbitrary";

they do not "contradict common observation and common sense." They do not "find refuge under some indeterminate and arbitrarily assumed factor, difficult of ascertainment," presumed by counsel for complainant to be found in the words "unlimited outflow," which words do not even once appear in Mr. Meyer's testimony on this subject.

In order to show that the solution is sound, the principles were applied by Mr. Meyer to Lake Superior and to the Lake of the Woods, along the international boundary of Minnesota. In both instances the same principle was found to hold true. It was found in both cases, as shown by defendant's Exhibits A-9 and A-10 (add. rec., pp. 113 and 114) that a slow rate of inflow resulted in a higher lake stage than a rapid rate of inflow. The computations for those two lakes are shown in defendant's Exhibit A-11 and A-12 (add. rec., pp. 115 and 116). In the case of both lakes, the natural inflow, as actually observed by agencies of the federal government, and the known relationship between lake stage and outflow, were used by Mr. Meyer. Unexpected as the result may be, the method is sound, straightforward and involves no assumptions whatsoever. *If there has been any material acceleration of in-flow into Lake Traverse as the result of Minnesota's ditching operations, the effect has been beneficial rather than detrimental in so far as the lands in Dakota along the Bois de Sioux River are concerned.*

(4) *It is Minnesota's position that the expense of the project suggested by her engineering experts should be apportioned on the basis of benefits conferred by the improvement.*

After having carefully weighed all considerations relative to the apportionment of the expense of the proposed project, the experts for Minnesota agreed that, since the ditching operations on the Mustinka watershed in no way increased the floods on the Bois de Sioux River, the cost of the project should be apportioned on the basis of the benefits conferred upon the lands, highways, railroads and other properties benefited by the improvement.

We quote from the testimony of Professor Meyer at page 49 of the additional record:

> "Q. Taking all these things into consideration, in your opinion what is the equitable basis for apportioning the expense of the construction of the project you have suggested among the three states referred to?
>
> A. In my judgment the equitable basis for apportionment is on the basis of direct benefits resulting from saving lands from overflow and affording outlets for drainage ditches, directly in proportion to the total area lying within each state of the two types mentioned; that is, the lands which would be saved from overflow and the lands which would be given drainage outlets."

And from the testimony of Mr. Morgan at pages 83 and 84 of the additional record:

"Q. I do not think we need go into that. Will you state now what you consider to be a proper basis for the equitable distribution of the cost of the project you propose among the states affected?

A. I consider that the equitable distribution of cost would be a distribution of cost in proportion to the benefits received by the lands directly benefited, the lands and property directly benefited by the proposed improvement on the Bois de Sioux river."

The matter of apportioning the expense on the basis of benefits was gone into in some detail by the witness. See Meyer, add. rec., pp. 40, 41 and 42; Morgan, add. rec., pp. 77 and 78; Bass, add. rec., pp. 90 and 91.

VIII.

THERE HAVE BEEN NO FLOODS SINCE THE FILING OF THE BILL.

It was agreed at the supplemental hearing that there have been no floods in the Bois de Sioux Valley since the filing of the bill of complaint; this was filed November 9, 1916. There being no dispute as to the fact, a stipulation was entered into. This was made a part of the record and returned therewith to this court. The stipulation appears at pages 98 and 99 of the additional record. The exhibit therein referred to and made a part thereof appears between pages 96 and 97 of this record.

The substantial portion of the stipulation reads as follows:

> "That attached hereto, marked Exhibit A and hereby made a part hereof, is a map or plat of the area of North Dakota here in question. That Exhibit A represents the present and normal conditions as to flooding in the valley of the Bois de Sioux River. That there have been no floods since the filing of the bill. Those portions of the map indicated in blue represent the presence of water. The government meander lines are indicated in red paralleling the river and the lake. The several tracts outlined in heavy black lines and numbered within circles from one to thirty-seven, which include lands claimed by complainant to have been damaged by flooding, are now, and since the filing of the bill (except as otherwise shown in the original record with reference to these conditions in the year 1917) have been, in the general condition outlined in said Exhibit A; that is, free from overflow by flood waters and used for the production of grains and grasses as thereon indicated.
>
> Nothing in this stipulation shall be held or construed as in anywise bearing upon the issue of damages or the effect produced by the floods described in the previous record on any of the lands involved."

It is sufficient, with reference to the facts disclosed, by this stipulation to say, that during the years 1917, 1918, 1919, 1920, 1921 and 1922 the North Dakota lands, claimed to have been flooded in 1915 and 1916 by reason of Minnesota's drainage system, were free from flooding and used for

agricultural pursuits, the same as prior to the years 1915 and 1916. In other words and in a nutshell, this region soon after 1916 returned to a condition of normalcy.

As heretofore pointed out, North Dakota's engineering experts at the original hearing testified that there was nothing in the meteorological conditions of the years 1915 and 1916 to account for the floods complained of. In other words, these years, in their judgment, were average years with respect to such conditions. In view thereof, they drew the conclusion that the floods were due to Minnesota's drainage system. The records of the United States Geological Survey for the region here material, according to Professor Chandler, show a deficiency in precipitation for 1917 of eight inches; a deficiency for 1918 of about two inches; an excess for 1919 of about four inches; normal for the year 1920; an excess for the year 1921 of about two inches; and an excess of one and one-half inches for the period from November 1, 1921, to April 1, 1922. (Add. rec. pp. 25 and 26.) (The records from April 1 to July 1, 1922, were not available at the time of the hearing.) The years 1917 to 1922, inclusive, were, then, we feel safe in asserting, average years as to meteorological conditions. In the light of this, we ask the question: If the floods of 1915 and 1916, years of average meteorological conditions, were caused by Minnesota's drainage system, why were there no floods during the years 1917 to 1922, inclusive, also years of average meteorological conditions?

The explanation is obvious. North Dakota's experts were in error in testifying at the original hearing that there was nothing in the meteorological conditions of the years 1915 and 1916 to account for the floods of those years. As we understand the testimony given by them at the supplemental hearing, they now concede that they were in error. They now say, in effect, that a part of the flooding was due to natural causes and a part to the ditching system; and they suggest a flood relief project to prevent a recurrence of the part due to the ditching system. We say that they are still in error. It is our position that the floods of 1915 and 1916 were caused by the excessive rainfall extending over the years 1914, 1915 and 1916, and the visitation upon or near the Mustinka watershed of storms of unusual magnitude. The soundness of this contention, we feel confident, is demonstrated by what has heretofore been said and by the brief filed in this cause in December, 1920.

At this point, attention is called to the testimony of Mr. Morgan appearing at pages 79 to 83, inclusive, of the additional record. Mr. Morgan's size-up of the whole situation is here disclosed. For the convenience of the court, we have attached an appendix to the brief, setting forth this testimony.

CONCLUSION.

In our previous brief it was stated that the Bois de Sioux valley had, prior to 1915 and 1916, been periodically flooded. Attention was directed to the floods of 1880, 1881, 1882, 1883, 1887, 1888, 1897, 1907, 1908. (Original brief, pages 23, 65-69.) There has been no flooding now for six years; but if history repeats itself, there will be floods again. If they come, they will come as they have in the past, during periods of abnormal precipitation. Clearly, the possibility of their recurrence is not such as entitles North Dakota to the relief sought. North Dakota's testimony, as pointed out, absolutely fails to prove that there will be excess flooding, due to Minnesota's drainage system, when a flood comes. Conceding, for the sake of argument, to the contrary, we submit that there is nothing in the record from which it can be found that such excess flooding will be of serious magnitude. It cannot be said, we submit, taking the testimony of both parties to the litigation into consideration, that the alleged threatened invasion of the rights of North Dakota by Minnesota has been proved by clear and convincing evidence. North Dakota has not brought herself within the rule of New York v. New Jersey, 256 U. S. 296, wherein, at page 309, Mr. Justice Clark said:

> " * * * the burden upon the state of New York of sustaining the allegations of its bill is much greater than that imposed upon a

complainant in an ordinary suit between private parties. Before this court can be moved to exercise its extraordinary power under the constitution to control the conduct of one state at the suit of another, the threatened invasion of rights must be of serious magnitude and it must be established by clear and convincing evidence. Missouri v. Illinois, 200 U. S. 296."

Respectfully submitted:

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APPENDIX.

Testimony of Arthur E. Morgan.

"A large area surrounding Lake Traverse composes what is known as the bed of Lake Agassiz. It is evidently the remains of an old lake. In some places the beach of that lake is very plainly in evidence. Its rim is in the shape of a saucer, that is, it is sloping at the edges but approximately flat at the bottom. Lake Traverse is the residual remains of a lake that was once of very much greater extent. That lake has been gradually disappearing, although this disappearance has been sometimes interrupted. It probably would have entirely disappeared but for the fact that the Minnesota River brought down debris or deposits that cut off its outlet. Similarly the Mustinka River in prehistoric times has built out a flat across Lake Traverse and divided it practically into two lakes. Except for those deposits, the general tendency has been for this lake to decrease in size, and is indicated in the general topography and formation of that country. This decrease has been gradually extending over hundreds of years, but it is not uniform. It is similar to very many lakes in western Minnesota, they are to a greater or less extent intermittent. I have personally surveyed and examined thirty or forty lakes, at least, in western Minnesota that are entirely dry in excessive dry years and then are full and overflowing during wet years.

These dry years and wet years do not occur with any regularity or consistency. Sometimes several dry years follow each other and sometimes several wet years follow each other. The extreme range can be indicated by the fact that here at St. Paul the annual rainfall has ranged from about 10 inches to over 45 inches, the highest annual rainfall being more than four times as much as the lowest annual rainfall. During dry years these lakes shrink in size and farmers cultivate further into the lake bottoms. In hundreds of cases the entire lake bottom is cultivated and good crops are raised in western Minnesota during dry years. Then wet years occur when the lake is full to overflowing. At such times there is a natural feeling on the part of the farmers that they have acquired a decided interest in this intermittent lake bed and there is always great activity for the draining of these lakes and for the recovery of damages from this harm done during wet years.

Mr. Boutelle: Just a moment, I am going to interpose an objection to this line of answer as to what farmers conceive to be their rights. I believe that the Supreme Court is sufficiently able to determine what the real rights are without any assistance on the part of the witness, and I move to strike out the last part of the answer as immaterial and cumbering the record.

A. These observations were based on my personal surveys of the entire area here, where the lakes did disappear in dry seasons and appeared again in wet years, and if we have a wet season

that activity is very general; that is a very common occurrence. In this intermittent bed of Lake Traverse there is a great deal of land that is sometimes above water and sometimes under water. In wet years it cannot be cultivated, in dry years it can be cultivated. Some of it is so near low water level that it can be cultivated only once in many years; some of it so high that it is overflowed only once in many years, and there are all stages between. There always have been such variations, so far as we know. So that this variation of level in Lake Traverse is a natural occurrence which has existed as far back as we have any knowledge.

Lake Traverse itself is a true retarding basin. It is surrounded by higher land, with only the inadequate channel of the Bois de Sioux River as an outlet. It is not entirely surrounded by a high rim but surrounded about 95 or 98 per cent. by such a rim, possibly 95 per cent. surrounded by such a rim, and in the area not so surrounded the land is so very flat as to not furnish an outlet. The Delta Zone of the Mustinka River, on the other hand, is an entirely different formation or has entirely different formation. An examination of Complainant's Exhibit A in the original case shows this fact very distinctly. The contour lines across the territory which it is claimed is a retarding basin run in fairly nearly straight lines. That is, it is a fairly curved slope, with nothing whatever in the nature of a rim around it, absolutely nothing in the nature of a rim around it.

It is a sloping prairie with a fall of about five feet to the mile. That fall is greater than the general slope, surface slope, over, say, half of the farm land of Illinois. It is a greater surface slope than exists almost anywhere in the rich farm lands of Arkansas, Missouri or Mississippi. It is a slope which in general would be adequate for drainage. The difference between this territory with a slope of five feet to the mile and Illinois and Ohio farm lands with the same slope is that this land in the moraine zone is fairly uniform. It has not the little local variations of small ridges and hollows.

Mr. Brown:

Q. You mean the moraine zone?

A. The Delta Zone, pardon me. The surface of this Delta Zone has a general pitch of five feet to the mile but is lacking in many of the little surface irregularities of a foot or more which are common in Illinois and other rich agricultural regions. So that, while the water travels across that country, it does so without gathering so much into little brooks and rivulets as it does in some territories. It is not in any sense whatever a retarding basin. The water on its surface is purely surface water. Mr. Shenehon testified in the former case that the water over that so-called retarding basin would be from 1/6 of an inch to two or three inches deep. A depth of water from 1/6 of an inch to two or three inches deep is purely surface water. That difference or variation may occur in almost any flat place, the little irregularities of almost any farm surface would be as great as that.

If that statement is correct as to the depth of that water then it could not have backed up more than—if there was any place where there was a rim the water would not have backed up back of that rim more than two or three feet to five feet deep. In fact, it has none of the characteristics of a retarding basin but it has all the characteristics of sloping, flat, prairie land. I could find no evidence, either on the ground or in the testimony, which indicates that this ever was a retarding basin.

Now, the so-called moraine zone of the Mustinka River, being the upper area of the watershed, is of an entirely different character. It lies very much higher and is a succession of hills and hollows and ridges. There are a vast number of little pot holes and swales that have no drainage at all. I have been over that ground very thoroughly. I know that comparatively little ditching has been done. The farmers have drained their little pot holes out, one to the other, but outside of that there has been practically no ditching in the moraine zone. There have been a few small ditches. That moraine zone consists of a surface layer of clay underlain by a bed of gravel. Some years ago in that territory, which is just east of Elbow Lake on this Exhibit A, which is indicated as sections 1 and 2, 35 and 36, 4 and 12, just northeast of Elbow Lake, I constructed several miles of ditch through its surface of clay soil, and found an outlet by digging a hole about three feet into the gravel, and that whole area of about four and a half miles has drained

since that time into the gravel without any overflow whatever.

That is an indication of the nature of that soil. This water seeps down into the bed of gravel and then flows toward Lake Traverse and tends to make that land more or less springy. As Mr. Meyer indicated it also brings some of the water to Lake Traverse by seepage. Hence the flow through the Mustinka River is the natural flow, plus a certain concentration of purely surface water.

I believe it is possible that that surface water has, to a small extent, added to the speed with which the water reaches Lake Traverse, and it may have added, to a small extent, to the total amount of water running off; that is, during the spring break-up, if that water had run off a little more slowly a little more would have evaporated, that is about the total difference. So far as flowing into Lake Traverse rapidly is concerned, I think that Mr. Meyer is exactly right in saying that a more rapid inflow would result in a lower crest stage of Lake Traverse. In my work in flood control I very many times had to work out the most economical size and shape of retarding basins, and it generally works out that a retarding basin is more heavily taxed by a long-drawn-out storm and inflow than it is by the same inflow coming at a shorter period. That is the result I have found over and over and over again by working out the actual behavior of a retarding basin.

The reason for that is this, that the crest does not occur,—for instance, here at Lake Traverse, the crest at Lake Traverse does not occur when the crest occurs on the Mustinka River. The lake commences to rise long after the crest has occurred on the river; until the outflow is greater than the inflow, that may be a varying length of time, the lake continues to rise and keeps on rising until the outflow is greater than the inflow. If all of that water could be put in in a short time, the outlet is at a higher stage during that entire time. You are getting more inflow and maximum outflow when the lake is filling rapidly than when it is filling slowly. We have worked out cases over and over again and it works out that a comparatively rapid inflow into a reservoir or retarding basin that brings your outlet into operation quicker will result in a lower crest in your basin, than in a case where the same amount of water flows in slowly. That is thoroughly proven by both the probable behavior of theoretical basins and such actual basins upon which figures can be secured. If you will put your water in there, all of it, without any reference or thought of the amount of the maximum crest but that your water inflow comes in gradually until the crest occurs and then there is a gradual tailing of the inflow in that basin while the basin is still rising, it is when the flow has gone down to a third or half of the maximum that your flow reaches its crest. If you can put the larger part of the water in quicker you are going to have better use of your outlet and a lower maximum

stage; so that the acceleration of this water into Lake Traverse would be a definite benefit and not a damage. If any additional water should come in that would tend to be a damage, but I believe that is but a small item.

Furthermore, there is another way in which the acceleration of that water into Lake Traverse is a benefit. Most of these floods occur in the early spring. When that water comes into Lake Traverse quickly when the snow melts and gets out again it may be gotten out of the way in time to allow crops to be planted, whereas if it comes ten days later it may interfere with planting.

I have calculated very carefully how far up-stream and away from these ditches the flow would be affected in the Mutsinka River. The effect of those ditches would be entirely lost within two miles up-stream; on the Twelve Mile Creek the effect of the ditches would be entirely lost from three to four miles up-stream. You can visualize that by considering rapids in a river. They will lower the water for a little distance up-stream until the friction is overcome and then the effect disappears. We have had to work that in many cases, in case of cut-offs on river banks, and our estimates there are not rough estimates, they are fairly exact estimates; so that only a small part of the watershed of the Mustinka River is affected by this Mustinka and the other ditches." (Add. rec., pp. 79 to 83, inclusive.)

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OCTOBER TERM, 1922.

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THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA,

BRIEF AND ARGUMENT ON BEHALF OF THE STATE OF NORTH DAKOTA ON THE ISSUES RAISED BY THE SUPPLEMENTARY PROOFS OFFERED UNDER THE ORDER OF THE COURT OF APRIL 18th, 1921.

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Supreme Court of the United States.

OCTOBER TERM, 1922.

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THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA,

BRIEF AND ARGUMENT ON BEHALF OF THE STATE OF NORTH DAKOTA ON THE ISSUES RAISED BY THE SUPPLEMENTARY PROOFS OFFERED UNDER THE ORDER OF THE COURT OF APRIL 18th, 1921.

This cause was argued and submitted on the pleadings and proofs in the early part of January, 1921, at which time it was taken under advisement by the court. On April 18th, 1921, the court entered its order restoring the case to the docket for the purpose of taking additional proofs as to the possibility, within the limits of reasonable expenditure, of doing away with or ameliorating the flood conditions along the Bois de Sioux River by means other than the injunction prayed for in the bill.

North Dakota v. Minnesota, 256 U. S. 220.

The order designated specific questions to which such additional proofs should be directed. These proofs have now been offered by the respective parties; the evidence

has been certified and returned to this court and the cause is ready for final submission.

PRELIMINARY STATEMENT.

As the order of the court directing additional proofs has been interpreted by the parties from diametrically opposite standpoints, and as the new evidence, offered by each has largely, if not exclusively, addressed itself to these differing interpretations, consideration of the questions, as now presented may be facilitated by a brief review of the issues originally submitted.

The Bill was filed by The State of North Dakota against The State of Minnesota, addressed to the original jurisdiction of this court and asserted in substance the commission of a trespass by Minnesota on the domain of the complainant State. Appropriate equitable relief was sought by an injunction, restraining the continuance by Minnesota of the agencies responsible for the trespass and reparation for the damages sustained.

Omitting details, the proofs established substantially as follows: The dividing line between the respective states in the area in question is the middle of the natural water courses, Lake Traverse and the Bois de Sioux River, which constitute the natural discharge channel for the tributary drainage area. The topographical conditions make Lake Traverse a natural reservoir or detaining basin for the flood waters of the tributary watershed which are discharged through its outlet, the Bois de Sioux River, a tributary of the Red River of the North.

The watershed is of comparatively low slope, more particularly on the North Dakota side. The natural channel

of the Bois de Sioux River is shallow and inadequate. In consequence in spring freshets following winters of excessive precipitation, the lands in North Dakota bordering this river have been subjected to periodic flooding.

Under the natural conditions, prevailing previously to the artificial changes made by Minnesota, these floods had been confined to the periods of spring run-off; had been limited in their duration from a week to ten days and had never prevented the use of such lands for the ordinary agricultural purposes for which they were adapted.

One of the largest watersheds in Minnesota immediately tributary to Lake Traverse is drained by the Mustinka River from which the watershed derives its name. Its area, in round figures, is 750 square miles.

The drainage of this entire area, owing to its peculiar, natural conformation, was concentrated in its western central part where, owing to the wholly inadequate channel of the Mustinka River, periodic inundations of relatively large areas in Minnesota occurred during spring break-ups and summers of excessive precipitation. These flood conditions were productive of serious damage to relatively large areas in Minnesota and with the object of effectuating relief, the State itself, as well as various of its local agencies, inaugurated a system of artificial drainage by the construction of a series of open ditches.

This work was inaugurated in Minnesota by the construction, through state agencies and state appropriations, of what is termed the original Mustinka State Ditch following the general direction of the channel of the Mustinka River for a distance of approximately 7 miles across the entire area affected. The ditch substituted for the wholly inadequate and tortuous channel of the river, a direct

discharge outlet of incalcuably greater capacity. Its construction resulted in transferring the flood burden to a point to the west, further downstream, with the result the latter area, which had not previously been affected by floods, was subjected to periodic inundations and heavy damage. To relieve the latter situation, application was made to the legislature of Minnesota for an additional state appropriation to extend the ditch construction. The subject was referred to a committee of investigation whose report confirmed the facts. Responsive to the latter's recommendation, provision for relief was made by legislative act (Ch. 138, Gen'l Laws of Minnesota, 1911). The preamble of this act embodies a full recital of the conditions. The act itself made a preliminary appropriation for extending the previous construction under the supervision of the State Drainage Commission. The latter work included the extension of the original ditch approximately two miles to the west to a point where it intersected the Mustinka River and the rectification and excavation of the latter's channel from this point to its outlet in Lake Traverse.

The new construction eliminated a long detour of the river to the north and substituted a direct outlet of lesser length and greater discharging capacity. The rectified channel shortened the distance and increased the discharging capacity in Lake Traverse. The work was completed to a point within approximately a mile of the ultimate outlet in the lake in 1914, and the intervening portion dredged in the following year.

In the fall of 1914, a limited flood occurred in the lake and the Bois de Sioux River. The flood waters receded after a relatively short period and no serious damage re-

sulted. The winter of 1914-1915 was not one of excessive precipitation and *no flood in the lake and Bois de Sioux valley occurred in the following spring.* In May, 1915, *after the period of spring flood had passed*, the waters in the lake and valley commenced to rise. At this time the entire tributary area was under cultivation and the grain had "headed." The waters continued rising until the latter part of July, resulting in the inundation of some 10,000 acres of the Bois de Sioux valley lands in complainant State. The crops in the inundated area were totally destroyed. There was a slight recession of the waters during the late summer and fall but for the most part the inundation continued into the winter when the waters froze over the entire area.

Such were the conditions with the spring break-up of 1916, when a flood of greater intensity than that of the previous summer and fall occurred in the lake and Bois de Sioux valley. The flood heights were increased and the inundated area in consequence enlarged. The conditions continued through practically the entire summer although the waters gradually receded. They were practically drained off late in the fall of 1916, but lands were left covered with a deposit of mud and silt and froze up in that condition in the winter. There was a total loss of their use so far as agricultural purposes were concerned during that year. The winter of 1916-'17 was one of low precipitation and the following summer (1917) was one of comparative drought. The inundated lands, with the opening of 1917, were grown up with rushes and water grasses and were an almost complete loss from the standpoint of the purposes of husbandry during that year.

The issues to which the original proofs were directed

addressed themselves primarily to assigning the responsible cause for these floods. It is unnecessary here to do more than mention the salient facts. It was shown that floods of the duration and intensity of those of 1915 and '16 had never previously been known in this area; that before the floods in question, the lands had never been inundated except at the time of spring break-up; that summer floods in the Bois de Sioux valley of other than negligible proportions were previously unknown, and that nothing in the meteorological conditions explained or accounted for these floods as these conditions were not essentially different from those which had periodically existed in previous years when no such flooding occurred.

The responsible cause for the floods was assigned to the artificial conditions created by Minnesota in the Mustinka watershed as a result of which, the burden of the accumulated waters previously confined or detained within this watershed, had been cast into Lake Traverse with the consequent surcharging of its natural reservoir capacity and the inundation of the lands bordering its outlet. Incidentally it was shown that a relatively large area of the Mustinka watershed had been gridironed by artificial drainage channels, all of which emptied into and were made effective by the main artificial channel constructed by the State. The effect of this construction, as stated by one of the experts, was to mobilize the waters of the watershed and provide a superior transportation system therefor to their ultimate outlet in Lake Traverse.

This artificial system resulted in discharging waters into the lake which otherwise would have remained in the watershed and been gradually discharged therefrom or lost by evaporation, seepage and other causes reducing run-off.

The natural and necessary effect of its operation was to discharge the waters in shorter time and therefore in greater volume into the lake. Under normal conditions, this increased discharge tended to reduce the storage or reservoir capacity of the lake and thus, to that extent, to impair its efficacy as a natural detaining or retarding basin for equalizing flood discharge in the Bois de Sioux valley in times of spring break-up, and during periods of excessive summer precipitation.

The conditions thus disclosed (the elimination of a natural detaining basin) were shown to be characteristic of those producing floods. The resulting effects were not to be confused with those of natural origin for the self-evident reason that whatever hypothesis was assumed for natural conditions, there was now superimposed on those conditions an added artificial condition which necessarily increased the flood levels.

The engineering features confirmed these conclusions and omitting details, disclosed that the increased run-off, resulting from the artificial construction, accounted, during the flood periods in question, for raising the level of Lake Traverse approximately one foot and thus explained the abnormal flood conditions in the Bois de Sioux valley.

It was further shown that the inevitable consequence of the continuance of these artificial agencies by Minnesota would be a repetition of the conditions of 1915 and 1916 in the affected area of complainant State during the periodic cycles of extreme snowfall in winter or abnormal precipitation in summer characteristic of this region.

Omitting features of the case directed exclusively at the damages resulting from the floods, the foregoing embodies in outline the case made by complainant. While issue was

made by Minnesota with respect to a number of the details, it was shown that the various contentions were either without substantial foundation in the facts or rested on impracticable and wholly untenable theories. In fact, it might be stated without fear of serious contradiction that the matters alleged in Minnesota's answer, coupled with the declarations of its legislature, constituted a practical admission of the substantive features of complainant's case.

In the situation thus indicated, the cause, as already stated, was submitted for final decision on the briefs and oral argument.

On April 18th following, the court entered its order directing the taking of additional proofs. This order expressed its purpose and the subjects to which the additional proofs should be addressed in the following terms:

> "To afford an opportunity for the taking of supplemental proof deemed by the court necessary to an adequate consideration and disposition of the cause, it is ordered that the case be restored to the docket to the end that the parties may proceed promptly to take the testimony of not exceeding three engineering experts on each side as to the possibility, within the limits of a reasonable expenditure, of doing away with or ameliorating the flood conditions along the Bois de Sioux River by means other than the injunction prayed for in the bill herein, the testimony thus to be taken to be particularly directed, among other things to the possibility and effect and estimated cost of any of the following projects: (a) the construction of detaining basins for drainage water throughout the watershed of the Mustinka River for the purpose of withholding a part of the spring waters until the flood period is past; (b) the construction of a sluice dam at any point in Lake Traverse for the purpose of increasing its capacity as a detaining basin; (c) artificial improvement in the channel of the Bois de Sioux River in order to improve its capacity as an outlet for the

waters of Lake Traverse in times of flood, so as to prevent overflow and the inundation of the Bois de Sioux valley, the work to include a sluice dam at the foot of Lake Traverse if necessary in order to maintain its level in times of normal flow; (d) lowering the level of Lake Traverse by means of an outlet to Big Stone Lake, controlled by a sluice dam, with a view to increasing its capacity as a detaining basin during the flood period; (e) by diverting some of the drainage water from the so-called Delta Zone, in order to discharge the same down the Mustinka River, to the Rabbit River.

It is further ordered that the parties may take the testimony of not exceeding three witnesses on each side concerning the proper equitable basis for apportioning the expenses of any feasible project among the states drained by the Lake Traverse—Bois de Sioux watershed, taking into account, among other considerations, the amount of water discharged by each state into Lake Traverse or the Bois de Sioux River and the benefit conferred by the improvement.

It is further ordered that testimony shall be taken sufficient to advise the court as to the flood conditions which have prevailed, since the filing of the bill herein, in the area claimed to have been flooded by the action of the State of Minnesota" (256 U. S. 220).

The interpretation of this order seemed obvious under the circumstances of its issuance and the subjects therein enumerated to which the new proofs were to be addressed. Had the evidence, as finally submitted, failed to substantiate complainant's claims on the merits, no occasion for further proofs would have arisen. On the other hand, if the claims of complainant were substantiated, the right to the ordinary and appropriate injunctive relief followed. Under the latter circumstances, the question whether the objective purposes of an injunction could be accomplished in an alternative method, through artificial agencies, was clearly pertinent.

In other words, if future repetitions of the trespass could be reasonably safeguarded by artificial agencies, Minnesota should be afforded the option of supplying such agencies, as an alternative to the otherwise necessary injunctive order.

Hence, as the single question in the case, in the aspect presently under consideration, *dealt with a trespass*, the scope of the newly required proofs would naturally address themselves and be limited to the same thing.

Nothing in the terms of the order suggested the re-opening of the issues on which the case had been tried and finally submitted. Furthermore, nothing in its terms suggested the additional proofs should transcend the issues of the case and enter the domain of non-justiciable subjects or controversies.

No responsibility attached to Minnesota for floods resulting from *natural conditions*. No legal redress for injuries from such floods could be sought by complainant. They were obviously *damnum absque injuria*. Relief therefrom, under circumstances such as those here presented, where several states were affected, was clearly *non-judicial* and if desirable, to be sought through the ordinary avenues of interstate negotiation with possible federal co-operation. Considerations of natural flood conditions or potential relief therefrom could not therefore be otherwise than wholly foreign to matters within the cognizance of the court.

On the other hanl, complainant was strictly within its legal rights, in invoking relief, through ordinary legal procedure, from floods resulting from artificial agencies, against those responsible for the creation and maintenance

of those agencies, where such floods resulted in a trespass on its domain.

Judicial relief, under such circumstances, would necessarily address itself to the elimination of such agencies or their control in such manner that the natural status would be restored.

Whether the relief consisted in the inhibition of the further maintenance of the agencies responsible for the wrongs, or, as an alternative to such inhibition, the control of those agencies by appropriate means, the objective, from the legal standpoint, would be the same, viz.: affording adequate relief against the injury complained of.

Interpreting the order of the court accordingly, the evidence of complainant addressed itself to a practical means of controlling and safeguarding *the resultant flood effects from the artificial drainage system constructed by Minnesota.*

The objective of the project as proposed by complainant was limited accordingly *to the restoration, as far as practicable, of the natural status.* Schemes or projects of general flood relief were excluded as wholly foreign to anything germane to the present controversy.

The foregoing explanation has been made perliminary to the statement of the new evidence for the dual purpose of emphasizing complainant's interpretation of the issue and of similarly emphasizing the diametrically opposite interpretation of Minnesota.

By reference to the evidence, which will be presently reviewed, it will be seen that Minnesota has interpreted the order as opening the entire issue previously submitted and as aimed at elucidating the practicability of some plan of *general flood relief* in the area affected. The proofs as

now submitted in Minnesota's behalf follow this interpretation. The single issue of legal cognizance, viz.: the trespass complained of, is by this method wholly eliminated from consideration and the case treated as an arbitration, whose objective was to ascertain the feasibility of a project of interstate flood relief.

STATEMENT OF THE EVIDENCE.

As the evidence will require detailed consideration in the later discussion of the varying features of the case to which it was addressed, only a brief review will be made at this point.

Summarized, the projects suggested by the court were directed at the feasibility of (a) constructing detaining basins in the Mustinka watershed; (b) the construction of a sluice dam in Lake Traverse; (c) the enlargement of the Bois de Sioux channel coupled with the construction of a sluice dam in Lake Traverse; (d) draining Lake Traverse into Big Stone Lake; (e) diverting the flood waters of the Mustinka watershed into the Rabbit River.

The experts of the respective parties are agreed that of the projects thus enumerated, only that in (c), viz.: the enlargement of the Bois de Sioux channel with controlling works at the outlet of Lake Traverse is practicable (Shenehon, Rec. pp. 3-5; Chandler, Rec. pp. 21-22; Meyer, Rec. pp. 33-34; Morgan, Rec. pp. 72-73).

The reasons assigned for rejecting the other projects involve differences in detail which are largely inconsequential. In substance, the objection to project (a) is that the cost of constructing detaining basins in the Mustinka watershed would be prohibitive and involve damage to large

areas therein. That to project (b)—the construction of a sluice dam at the outlet of Lake Traverse—is that it would involve the flooding of large areas and owing to the limited outlet capacity of the Bois de Sioux River, would afford only partial relief. That to project (d)—draining Lake Traverse into Big Stone Lake, is, that while entirely practical, it would impose a flood burden on the latter lake and the Minnesota River as its outlet which already have flood problems of their own as serious, if not more serious, than those in the area in question. That to project (e)—diverting the flood flow into the Rabbit River is—that it would be productive of greater flood conditions than now obtain, as it would result in the elimination of the present equalizing effect of Lake Traverse as a detaining basin.

While the experts are agreed as stated, that project (c)—the enlargement of the Bois de Sioux channel in conjunction with the construction of a dam or sluice way at the outlet of Lake Traverse, presents the practical method of flood control, the differing conceptions of the objective purpose has resulted in the proposal of widely different plans with respect to the character of the required improvement. It will be observed however, in the later consideration of these differences that the divergence is in matter of detail rather than principle.

Viewing the objective purpose as one contemplating an improvement by Minnesota which would offset and equalize what for convenience we may term *the excess floods,* resulting from the artificial construction in that state, the experts of complainant have proposed a plan, combining the elements of a dam and sluice way at the lake outlet with enlargement of the present Bois de Sioux channel, aimed at this single result. In other words, assuming that

the excess flood flow, due to artificial causes, has been determined with reasonable accuracy and that the resultant effects, so far as the lands in the Bois de Sioux valley are concerned, have been similarly ascertained, the project as proposed by the experts of complainant has aimed at safeguarding a repetition of these conditions, with reasonable allowances for varying natural phenomena, as factors of safety (Shenehon, Rec. pp. 6, 7).

No attempt has been made to evolve or prescribe a project for general flood relief—that is, a project calculated to safeguard floods occurring under natural conditions and which would therefore have occurred wholly independently of the changes effected by Minnesota through the system of artificial drainage (Shenehon, Rec. p. 20).

Thus limited with respect to its objective purpose, the project, as propounded by the experts of complainant, while similar in principle as well as in design, is of lesser magnitude as well as cost than that advocated by Minnesota's experts.

The latter, on the other hand, viewing the matter as one involving complete flood relief in the area effected, propose an interstate undertaking on much larger scale, incidentally involving projects of local drainage and imposing the resultant cost on the various states under a system of apportionment of that cost, ostensibly based on the respective benefits.

The resultant expense of the installation proposed by complainant is slightly in excess of $100,000 (Rec. p. 12)—a cost which, under complainant's theory that the remedy proposed is the alternative of an injunction, would be assumed by Minnesota alone.

The estimated expense of the plan proposed by Minne-

sota's experts—which, as already stated, wholly excludes the idea of an alternative for an injunction—is approximately $500,000 (Rec. p. 40), and by far the greater part of this expense, upon the suggested basis of apportionment, would be imposed on complainant (Rec. pp. 41, 42).

Incidentally and for its bearing on matters to be later considered, the experts of Minnesota refer to Bulletin No. 1017 issued by the United States Department of Agriculture on March 31st, 1922, entitled, "Report on Drainage and Prevention of Overflow in the Valley of the Red River of the North" (Rec. p. 35). For present purposes it will suffice to state that the bulletin in question was prepared by P. T. Simons, Senior Drainage Engineer, and includes a study of the flood conditions of the entire watershed of the Red River of the North, of which the area in controversy in this case constitutes a relatively small part.

In its broader aspect, the subject comprised in the bulletin covers some 36,000 square miles of watershed area and about 432 linear miles of river flow from the head of Lake Traverse to the outlet of the Red River of the North beyond the Canadian boundary. The report, however, subdivides the larger project, treating that of the Lake Traverse and Bois de Sioux watershed independently. For the latter purpose the watershed area is taken as extending from the southerly limits of Lake Traverse north to Fargo, a distance of approximately 70 linear miles, and the watershed area involved as approximately 6,500 square miles.

See Bulletin, p. 24 (Figure 5), and 26 (Table 7).

The flood relief project here proposed differs rather in detail than in principle from that approved by the re-

spective experts in this case. Thus all are agreed that the basic objective is utilizing the capacity of Lake Traverse as a storage or detention reservoir. The Simon's report contemplates creating a storage capacity much larger than that proposed by the experts of either of the parties to this cause. It contemplates the accomplishment of this result by the construction of a levee at the south end of Lake Traverse with a dam and sluice-way across the valley at the outlet of the lake (the point agreed by all of the experts in this case), and the enlargmnt of the Bois de Sioux channel to a materially greater extent than proposed in the present case.

The experts of complainant exclude the Simons project from consideration as one involving general flood relief and therefore wholly aside from the issues. The experts of Minnesota accept the Simons project in principle but assert that the magnitude of its construction detail and the estimated expense of its installation ($1,400,000) are wholly disproportionate to the contemplated benefits (Rec. p. 36).

The experts of complainant contend that the limited project as proposed by them in this case, if carried out, would be available, as so much work already accomplished, toward the larger project embodied in the Simons report if the latter in the future were to be deemed desirable and undertaken. This for the reason that the dam across the valley of the Bois de Sioux, as proposed by them, is located at the same point as that designated in the Simons report and surveys; that the increase in the elevation of that dam to meet the requirements of the larger project, would involve nothing more than additional excavation; that increased sluice-way capacity for the larger project

could be provided by supplying additional units, and that the dredging of the lake channel and that of the Bois de Sioux under the smaller project would be just that much yardage removed, if the larger were undertaken (Rec. pp. 94-95).

The experts of Minnesota, on the other hand, assert that installation of the project as proposed by complainant's experts would prove inimical to the larger undertaking (Rec. p. 84).

A later examination of the testimony however will disclose that the objections on this feature are both trivial and superficial.

In thus approaching the more detailed features of the evidence, it will be observed that so far as the facts themselves are concerned, there is substantially no controversy for the reason that the parties have addressed their proofs to wholly different conceptions of the issue. The objective purpose of complainant's experts has already been stated and need not therefore be repeated. If that conception is correct it may be stated without fear of serious contradiction that Minnesota has not attempted to controvert the facts.

The evidence of Minnesota's experts was addressed, as already stated, to features of general flood relief which were not conceived by complainant as pertinent to the issues and are similarly not controverted.

In addition to the matters thus referred to, Minnesota, over complainant's objection, offered further testimony by its experts covering the general subjects of run-off from the Mustinka watershed and the effect of the ditch construction on the flood heights in Lake Traverse and the Bois de Sioux valley. The objective of this evidence was

clearly to re-open and re-try features of the case exhaustively presented on the original hearing. Complainant seasonably objected to this line of proof on the grounds stated and the same was received and reported to this court subject to the objection (Rec. pp. 44-45).

The only other feature of the case to which inquiry was directed by the court's order had reference to the flooding conditions since 1916. The evidence of complainant showed in substance that no flooding had occurred in the intervening period which had included a cycle or series of dry years, during which the annual precipitation had varied from the abnormal drought of 1917, to the normal mesne or an amount slightly in excess thereof (Rec. p. 25).

To save cumbering the record, this feature of the case was included in a stipulation between the parties which has been returned with the evidence to this court (Rec. pp. 98-99).

ARGUMENT.

I.

Consideration of Conflicting Theories Respecting the Objectives of the New Evidence.

It is seemingly self-evident that the question thus suggested must be determined at the outset, otherwise, argument addressed to the evidence may embrace purely moot issues.

Succinctly expressed, this question resolves itself on ascertaining whether the matters stated in the order of the court and to which the new evidence was to be addressed, contemplated on the one hand, an alternative to an in-

junction by remedial measures calculated to effect substantially the same relief which would result from an injunction, or, on the other hand, something entirely transcending such an alternative and substituting therefor a remedy wholly outside that sought by the bill or responsive to the matters therein complained of.

Assuming the correctness of the former of these interpretive possibilities, no serious question has been or can be raised as to its legal propriety. If the agencies, for the result of whose action Minnesota is here shown to be responsible, are susceptible of control in such manner as to preclude the future repetition of the dangers of their uncontrolled operation and if by such control complainant would be afforded the relief to which it is entitled, an alternative injunction order affording Minnesota the option of effecting such control, failing in which the injunction would issue as prayed for in the bill, would be entirely consistent with established principles of equitable procedure.

This question was considered from a different angle in our original brief, in the light of the possibility of the claim that under the rule announced by this court in *New York City v. Pine*, 185 U. S. 93, and other precedents of similar import, an award of damages might be substituted in the instant case for an injunction.

It was then and is still contended that the rules, applied in the cases referred to, have exclusive reference to matters of *private right* and were for the most part invoked under circumstances where the right of eminent domain existed. Furthermore, that the attempted extension of these rules to cases arising between independent states would be tantamount to recognizing the right of enforced appropriation of the domain of one state by another—a result

which can find no justification either in principle or precedent in our laws.

The remedial alternative, contemplating Minnesota's control of the agencies created by her, has, as already stated, been assumed by the complainant as the objective of the new evidence and to this feature the proofs now submitted by it have been directed.

Minnesota, on the other hand, excludes all reference to the feature of injury and damage for which her agencies have been responsible and treats the question involved as directed at determining the expediency and feasibility of protecting the several states affected from a common enemy, viz.: all floods, regardless of origin.

To this feature and this alone, the new proofs submitted by Minnesota have been directed.

The contention thus advanced is, to say the least, novel and is believed wholly impossible of substantiation whether considered from the standpoint of precedent or principle. Furthermore, if this theory of the case be held untenable, the presently submitted proofs by Minnesota are of necessity excluded as wholly immaterial.

The matters thus suggested may be considered under the following headings:

(a) *Questions Dealing with General Flood Relief are Wholly Foreign to the Issues here Presented and Involve Subjects of Political as Contradistinguished from Legal Concern.*

1. The *gravamen* of the instant case consists in the unlawful trespass of one state upon the domain of another. If the trespass is not disclosed by the facts, the case necessarily fails. If the trespass is established, the right to ap-

propriate relief necessarily follows. Such relief addresses itself exclusively to remedying the wrong complained of. While its precise form may be adapted to the circumstances the objective remains the same and is limited accordingly.

Both rights and redress in legal procedure necessarily confine themselves to subjects of judicial cognizance.

Matters themselves pertaining to relief from natural conditions, for the existence of which no legal responsibility exists, are obviously without the scope of a justiciable controversy. In the case of causes of natural origin, affecting the interest of the community at large, the subject of redress is of public or political as contradistinguished from legal character.

As applied to the facts of this case, the circumstance that the general area in question is subject to periodic flood inundation, due to wholly natural causes, as well as the further circumstance this area includes portions of the domain of different states, present nothing of judicial cognizance.

The results as well as the remedies therefor are purely matters of legislative concern to be determined by the respective policies of the interested states. It is fundamental that no state can enforce its policies against any other without the latter's consent. No principle of law with which we are familiar invests the courts with jurisdiction over such matters or the power to compel the observance by one state of some general policy proposed by another on the assumed ground of mutual benefit from its adoption.

Any such conception would involve the assumption of judicial power to arbitrate matters of policy between the states which concededly does not exist.

It is not conceived how the circumstance one state has committed a wrong against another can in anywise change these conclusions. The state which has been wronged may or may not be afforded relief. The relief in this regard, however, should be made to turn on the rights involved and the wrongs perpetrated and not be conditioned upon assenting to the imposition of terms wholly transcending, if not entirely foreign, to the matters submitted for judicial determination.

2. We assume in this case, as already stated, that Minnesota has committed a trespass on the domain of complainant. The demand for relief from this trespass is met by the assertion that its effects are not dissimilar from other encroachments on complainant's domain, ascribable to wholly natural causes. Hence, complainant can have no relief from the trespass, though the right thereto is clearly established, unless it assents to a general plan of internal improvement contemplated to safeguard both future repetitions of the trespass and the encroachments by natural causes. In other words, Minnesota may have complete immunity from her unlawful acts heretofore and hereafter unless complainant assents to an extended scheme or project of interstate improvement to be jointly undertaken and participated in by both states.

Not only this, but on the theory of apportioning the cost as now propounded by Minnesota (a matter for more detailed consideration later) from two-thirds to three-fourths of the total expense of this joint project must be assumed by complainant.

From the standpoint of principle it would require but a step further to say that complainant could have redress, for the wrongs committed against it, on condition it would safe-

guard a repetition of those wrongs at its own expense.

Viewed from a slightly different angle, upon application of this theory, any state, so situated as in its judgment to make some great project of internal improvement, of interstate character, desirable, could initiate that improvement by trespassing on the domain of its neighbor, thus forcing the latter to the alternative of condoning the trespass or accepting the project.

The whole theory thus advanced is clearly subversive of the ordinary principles of equity, resulting in its application, in reversing the rules of equitable relief, in that it penalizes the party against whom the wrong has been perpetrated; extends immunity to the wrongdoer and conditions relief from the wrong on a concession by the party wronged in favor of the perpetrator of that wrong.

Seemingly a complete answer appears in the suggestion which this theory wholly overlooks, viz.: that Minnesota should first make proper amends for the trespass for which she is responsible; that such amends are matters of ordinary legal cognizance to be appropriately determined and enforced by the established tribunals having jurisdiction of the subject and upon the application of settled rules, and that, if, after this has been done Minnesota conceives that a great project of internal improvement will prove of mutual advantage to her neighbors and herself, this non-justiciable and non-judicial subject should be addressed by her to the only agencies having jurisdiction of such matters, viz.: the legislatures of the respective states and possibly the National Congress.

(b) The Assumed Equity Invoked by Minnesota is Opposed to Principles of International Law and Inapplicable in a Suit by a Sovereign State for Redress from Foreign Aggression.

Apart from the matters last mentioned, consideration of the ostensible equities assumed to justify Minnesota's contention, will disclose that such equities are purely fictitious.

It may be conceded that in the ordinary case involving strictly *private rights* and possibly in certain others where public rights are presented in their application to the affairs of *a single commonwealth*, it is broadly established that the right to injunctive relief addresses itself to the legal discretion of the court. Incidentally to the exercise of this descretion, the courts may and frequently do "balance the equities" and rest the ultimate judgment on determining the comparative loss to be sustained on the one hand, by granting, and on the other hand, by refusing injunctive relief.

Underlying these rules are the broader precepts that the granting of an injunction is not ordinarily a matter of right and that "he who seeks equity must do equity."

Hence, in ordinary cases, the granting of injunctive relief has been conditioned on the varied requirements suggested by the facts and appealing to the conscience of the Chancellor. The limitations on the conditions that may be thus imposed in the exercise of this legal discretion, need not for the present be considered.

The principles recognized by this court in *New York City v. Pine, supra,* have been applied under a great variety of circumstances.

See Vol. 18 Rose's Notes, 1061, 1062, 1063.

Broadly expressed, this rule is to the effect that where works of public or quasi-public character have been undertaken and carried on at great expense to full or partial completion, private rights affected or damaged which, if promptly asserted in the work's inception, might have been protected by injunctive relief, may be denied that relief, where there is unreasonable delay in asserting the right, and an award of damages substituted.

In many of the cases the application of the rule is limited to the circumstance the right of eminent domain exists, but has not been exercised. Under these conditions, injunctive relief is denied conditionally on the payment of damages assessed by the court.

As illustrative of the principle involved, attention may be directed to the following:

No. Pac. Ry. Co. v. Smith, 171 U. S. 260-271.

Western Union Telegraph Co. v. Pennsylvania R. R., 195 U. S. 540.

Western Union Telegraph Co. v. Louisville, etc. Ry., 250 Fed. 199.

Woodlawn etc. Bank v. Drainage District, 251 Fed. 568.

Eastern Oregon Land Co. v. DesChutes Ry., 213 Fed. 897.

Camper v. City of Chicago, 215 Fed. 706.

The decision of this court in *New York City v. Pine, supra*, extended the rule to a case where the right of eminent domain did not exist, disproving the decisions of the New York Court of Appeals in *Henderson v. Central R. R. Co.*, 78 N. Y. 423, and *Pappenheim v. Metropolitan, etc. Ry.*, 128 N. Y. 436, and on the authority of *Osborne v. Missouri*

Pac. Ry. Co., 147 U. S. 248, held in substance that injunctive relief might be denied and redress by way of damages substituted where unreasonable delay or other circumstances estopping the claimant from asserting the right to the former relief appeared.

Notwithstanding the number and variety of precedents in which the foregoing or similar principles have been applied, it is not conceived they have any application or bearing in the instant case.

In each instance these cases, as already stated, have involved strictly private rights or rights of a public or quasi-public nature confined *to a single state*. Whether disposed of on application of general legal or equitable principles which may be assumed as broadly applicable in all states and tribunals where such questions arise, sight must not be lost of the single essential and distinguishing fact that they have dealt with matters which for convience we may term, of strictly local and internal concern.

It has been settled from the earliest cases that the ordinary equitable principles of *laches* and equitable estoppel, as well as statutes of limitation (except where the latter are voluntarily self-imposed) are not applicable to the general government.

United States v. Kirkpatrick, 9 Wheaton, 720, 735.
Camfield v. United States, 167 U. S. 527.
Light v. United States, 220 U. S. 523, 535.
Steele v. United States, 113 U. S. 130.
United States v. Thompson, 98 U. S. 489.
Stanley v. Schwalby, 147 U. S. 515.
See generally, Note to *Bannock County v. Bell*, 101 Am. St. Rep. 140-144.

This is merely an application of the maxim, "*nullum tempus occurrit regi.*"

As stated in *United States v. Kirkpatrick*, *supra*:

> " This maxim is founded, not in the notion of extraordinary prerogative but upon a great public policy."

The foundation and reason of the rule renders it as applicable to the states in matters pertaining to their soverign rights as such, as to the general government.

See *People v. Gilbert*, 18 Johns. 227.

As stated in substance by Story, J., in *United States v. Hoar*, 2 Mason, 311 (Fed. Cases No. 15373) though it has sometimes been called a prerogative right it is in fact nothing more than an exception or reservation introduced for the public benefit and equally applicable to all governments.

While, therefore, rules conceived from the standpoint of weighing considerations of general public good as against arbitrary private right, may be invoked as determinative where only private rights or affairs concerned with the domestic policy of a single state are involved, neither precedent nor principle justifies the extension of those rules in the field of international law where sovereign rights are infringed from without, whether by another government or its nationals.

This was clearly indicated by Mr. Justice Holmes in delivering the opinion of the court in *Georgia v. Tennessee Copper Co.*, 206 U. S. 230-237, as follows:

> "Some peculiarities necessarily mark a suit of this kind. If the State has a case at all, it is somewhat more certainly entitled to specific relief than a private party might be. It is not lightly to be required to give up *quasi*-sovereign rights for pay; and, apart from

the difficulty of valuing such rights in money, if that be its choice *it may insist that an infraction of them shall be stopped*. The states by entering the Union did not sink to the position of private owners subject to one system of private law. This court has not quite the same freedom to balance the harm that will be done by an injunction against that of which the plaintiff complains, that is would have in deciding between two subjects of a single political power. Without excluding the considerations that equity always takes into account, we cannot give the weight that was given them in argument to a comparison between the damage threatened to the plaintiff and the calamity of a possible stop to the defendants' business. * * *

It is a fair and reasonable demand on the part of a sovereign that the air over its territory should not be polluted, * * * that the forests on its mountains, be they better or worse, and whatever domestic destruction they have suffered, should not be further destroyed or threatened by the act of persons beyond its control. If any such demand is to be enforced this must be, notwithstanding the hesitation that we might feel if the suit were between private parties, and the doubt whether for the injuries which they might be suffering to their property they should not be left to an action at law" (Italics ours).

Had the language thus quoted referred to the situation and issues disclosed in the case at bar, it could not have more concretely expressed complainant's contention.

The following from the same opinion is equally pertinent:

"This is a suit by a State for an injury to it in its capacity of *quasi*-sovereign. In that capacity the State has an interest independent of and behind the titles of its citizens, in all the earth and air within its domain. * * *

The caution with which demands of this sort, on the part of a State, for relief from injuries analogous to torts, must be examined, is dwelt upon in *Missouri v. Illinois,* 200 U. S. 496, 520, 521. But it is plain that

> some such demands must be recognized, if the grounds alleged are proved. When the States by their union, made the forcible abatement of outside nuisances impossible to each, they did not thereby agree to submit to whatever might be done. They did not renounce the possibility of making reasonable demands on the ground of their still remaining *quasi*-sovereign interests; and the alternative to force is a suit in this court."

The statement last quoted, exemplifies the situation in the present case. Complainant charges a trespass—the unlawful invasion of its domain by force. But for the constitutional compact, redress for such wrongs would be sought in diplomatic negotiation, repulsion or retaliation. The substituted redress contemplated by the Constitution necessarily presupposes the recognition of the basic and fundamental rights pertaining to the status of independent sovereign states. Otherwise, and if sight be lost of this essential, the whole scheme of international law committed to the jurisdiction of this court is reduced to the level of private municipal law.

Notwithstanding, therefore, the substitution of judicial procedure with the necessary resort to and application of established principles of law as expounded by this court in *Kansas v. Colorado*, 206 U. S. 46, 97, 98, considerations of of the international status and international rights must predominate.

Appropriate relief must recognize the rights asserted as pertaining to sovereign states and the wrongs complained of as an invasion of those rights. Such relief must be adapted accordingly *with the single objective, however*, of redressing the grievance upon application of the principles of international or common law or equity as stated in *Kansas v. Colorado, supra.*

In the light of these rules, complainant insists on its right to redress for the trespass complained of, to the exclusion of all foreign considerations. That this remedy should not be circumscribed or hedged about with conditions and restrictions to which, as a state, it would not be called upon to submit, except as a result of its voluntary action. That no assumed equity requires its submission, as a condition to relief, to something which, lies wholly outside the subject-matter.

That the alternative suggested by Minnesota is not directed to the wrong complained of or adapted to rectifying that wrong. That it has no reference to the adjustment of the equitable rights of the parties.

That the circumstance the relief thus proposed may incidentally accomplish *all and more* than complainant claims, begs the question. Finally, that the remedy so proposed is not a remedy in any legal or equitable sense, and its recognition as a condition to relief, tantamount to a complete denial of redress.

(c) *The Injection of Questions of General Flood Conditions and Possible Projects of Flood Relief Excludes the Cause from Justiciable Controversies; Aims to Transfer Jurisdiction from the Court to the Legislatures of the States Concerned; Excludes the Prompt Administration of Relief and Seeks to Condition any Relief on an Enforced Agreement Between States.*

1. The position of complainant in the aspects last considered is not to be taken as denying the application of equitable principles in the solution of the present controversy. Nor should it be taken as indicative of a refusal on complainant's part to recognize its own equitable obli-

gations and responsibilities in the premises. The sole objective has rather been to correctly ascertain what equities are appropriately to be considered in a matter of this character. The further objective has been to confine this cause within the limits of a justiciable controversy, every issue in which may be settled and disposed of by the court in the ordinary manner and in the exercise of ordinary judicial functions without the necessity of invoking action of independent tribunals or agencies beyond the court's control.

The matters now argued by Minnesota embrace subjects, as already stated, wholly foreign to those to which the jurisdiction of the court extends. They invoke, of necessity, in their consummation, the judgment and decision of other tribunals and agencies over whose action the court has no control. Such considerations demonstrate that the matters themselves are necessarily foreign to anything which may appropriately be termed *the equities of the case.*

Practical cconsiderations of ordinary experience sufficiently attest the results of interpolating the conditions, contended for by Minnesota, on the decree in a cause of this character.

Upon this hypothsis, the subject must be re-referred for consideration and appropriate action of the legislatures of the several states concerned. In ordinary course, concurrent or harmonious results could not be had from the independent action of such legislatures, considering the various questions of policy and self-interest at stake. The most that could be hoped for, would be an agreement on the creation of a joint commission, to investigate and report back the results with their recommendations. Assuming (which is at best doubtful) that in course of time such

a commission could reach and report back a unanimous agreement, the whole matter must necessarily be re-reviewed and approved by the legislature of each state concerned.

If this result be assumed as within the limits of possibilities, the question of the effect of section 10, article 1 of the Federal Constitution, excluding agreements between states without congressional assent, presents itself.

See *Virginia v. West Virginia*, 246 U. S. 565, 596.

Apart from all other considerations, the injection of collateral features and conditions of this character, with their inevitable consequences of procrastination and delay, is opposed to fundamental equitable concepts, which presuppose efficiency and promptitude in the relief accorded by equitable tribunals.

Boyce v. Grundy, 3 Pet. 210.

Tyler v. Savage, 143 U. S. 79.

2. A still more serious difficulty is encountered in the circumstance that under whatever guise, conditioning the relief here sought on the matters proposed by Minnesota, may be expressed, the results, in their last analysis, are tantamount to conditioning that relief on the compulsory agreement between the states. This is accomplishing by indirection that which this court has recognized it has no power or jurisdiction to do directly.

In *Kansas v. Colorado*, 206 U. S. 46, a number of the questions with which we are here concerned, including that last above suggested, were dealt with. Thus in defining its jurisdiction the court said:

> "Nor is our jurisdiction ousted, even if, because Kansas and Colorado are states sovereign and independent in local matters, the relations between them

depend in any respect upon principles of international law" (p. 97).

In defining the relations between the states, it is said:

> "One cardinal rule, underlying all the relations of the states to each other, is that of equality of right. Each state stands on the same level with all the rest. It can impose its own legislation on no one of the others, and is bound to yield its own views to none" (p. 97).

Speaking of the issue there involved, it was said:

> "Surely here is a dispute of a justiciable nature which must and ought to be tried and determined. If the two states were absolutely independent nations it would be settled by treaty or by force. Neither of these ways being practicable, it must be settled by decision of this court" (p. 98).

Distinguishing such cases from those of ordinary private nature, it was said:

> "It is the State of Kansas which invokes the action of this court. * * * The controversy arises, therefore, above a mere question of local private right and involves a matter of state interest and must be considered from that standpoint. This changes in some respects the scope of our inquiry."

After speaking of features which might be regarded as determinative of the issue if presented between private parties, the opinion continues:

> "We do not intimate that entirely different considerations obtain in a controversy between two states. Colorado could not be upheld in appropriating the entire flow of the Arkansas River, on the ground that it is willing to give, and does give, to Kansas something else which may be considered of equal value. *That would be equivalent to this court's making a contract between the two states, and that it is not authorized to do*" (Italics ours).

The analogy to the matters thus suggested by the court in the opinion quoted is apparant. In lieu of relief for the wrong committed by her, Minnesota proposes to give as an equivalent, something else, which she assumes will be equally efficacious in redressing that wrong. The substituted redress thus proposed is necessarily conditioned on the agreement between the states concerned, Acceptance of the agreement is to be enforced by making such acceptance the condition to granting complainant relief. Further argument seems unnecessary in the light of the authority last quoted.

3. In conclusion on this feature, if it shall be contended that complainant, in the position here assumed, refuses "to do equity," the answer is so far obvious as to hardly require statement. It is self-evident that Minnesota has injected this collateral phase into the controversy, with a view to evading all responsibility and with the object of transferring the decision of this controversy from the court to the legislatures of the several states concerned where ultimate redress may be postponed, if not wholly lost, as a result of the interminable delays incident to matters of this kind.

By reference to Government Bulletin 1017, above referred to, it will appear that the subject of general flood relief in the area in question has been under consideration, spasmodically, by the legislatures, voluntarily constituted commissions from the several states and by the National Congress for upwards of seventeen years last past. If, under the guise of conditioning the relief here sought on assumed equities, ultimate redress may be transferred from the court to the same agencies, the result is not difficult to forecast.

(d) Questions Relating to General Flood Conditions and Projects of Relief Therefrom are Wholly Foreign to the Subject-matter and Without the Cognizance of a Court of Equity.

Passing the several matters above considered and conceding the decree to be rendered herein should take cognizance of existing conditions and be so adjusted as to recognize to the fullest extent the equality of right of the parties, it remains to be considered upon what possible hypothesis the matters proposed by Minnesota can be considered as germane to the *equities of the case*. The assumption of prospective benefits furnishes no answer to the problem.

The same is true of the assumption that complainant would receive all of the relief to which it is entitled and something more. Whether such would or would not be the result depends largely, if not entirely, on the side from which the matter is viewed. Complainant's viewpoint has already been indicated and need not therefore be repeated. Furthermore, complainant is not looking for gratuitous favors or donations and is skeptical of any procedure, which masquerading under the cloak of equity, seems to force such gratuitous or donations upon it against its will. Nothing in the principles of equity sanctions or requires any such thing as a condition to the legal relief which complainant claims and to which it is clearly entitled. The contention must therefore be rested on the assumption that the imposition of the conditions contended for is best calculated to work out the equities between the parties. This last in deference to the principle that he who seeks equity must do equity.

Any such argument, if made, is immediately confronted

with two insuperable objections:

First: The assumed equity is foreign to the subject-matter of the controversy. Any injury which Minnesota may have received from floods of natural origin, is a matter for which complainant is in no wise responsible. Such conditions give rise to no equitable right on the part of Minnesota against complainant. Lacking such qualities, the subject presents no features of equitable cognizance requisite to the adjustment of the controversy between the parties. Its presentation and consideration involves the clearest violation of established rules.

In the frequently cited case of *Hanson v. Keating*, 4 Hare, 1, 4, the principle was thus stated by Wigram, V. C:

> "The argument in this case for the defendant was founded upon the well established rule of this court, that a plaintiff who would have equity must do equity, a rule by which, properly understood, it is at all times satisfactory to me to be bound. * * * The rule, as I have often had occasion to observe, cannot *per se* decide what terms the court should impose upon the plaintiff as the price of the decree it gives him. It decides in the abstract that the court, giving the plaintiff the relief to which he is entitled, will do so only upon the terms of his submitting to give the defendant such corresponding rights, (if any) as he also may be entitled to *in respect of the subject-matter of the suit.* What those rights are must be determined *aliunde by strict rules of law*, and not by any arbitrary determination of the court. * * * The court will execute the matter *which is the subject of the suit*, wholly, and and not partially. * * * I know of no case which cannot be explained upon this or analogous reasoning; and my opinion is, that the court can never lawfully impose merely arbitrary conditions upon a plaintiff. only because he stands in that position upon the record, but can only require him to give the defendant *that which by the law of the court, independently of the mere position of the party on the record, is the right of the defendant in respect of the subject of the*

suit. A party, in short, does not, by becoming plaintiff in equity, give up any of his rights, or submit those rights to the arbitrary disposition of the court. He submits only to give the defendant *his rights in respect of the subject-matter of the suit*, on condition of the plaintiff obtaining his own." (Italics ours.)

The same rule is stated by Prof. Pomeroy in the text to which the decision last quoted is appended in a note as follows:

"The meaning is, that whatever be the nature of the controversy between two definite parties, and whatever be the nature of the remedy demanded, the court will not confer its equitable relief upon the party seeking its interposition and aid, unless he has acknowledged and conceded, or will admit and provide for, all the equitable rights, claims and demands justly belonging to the adversary party, and growing out of or necessarily involved in the subject-matter of the controversy. It says, in effect, that the court will give the plaintiff the relief to which he is entitled, only upon condition that he has given, or consents to give, the defendant such corresponding rights as he also may be entitled to in respect of the subject-matter of the suit."

Vol 1, *Pomeroy Eq. Jur.*, 3rd Ed., Sec. 385.

In the same connection the same author states further as follows:

"It is undoubtedly true, as said by Vice-Chancellor Wigram, that the court obtains no authority from this principle to impose any arbitrary conditions not warranted by the settled doctrines of equity jurisprudence; the court cannot deprive a plaintiff of his full equitable rights, under the pretense of awarding to the defendant something to which *he has no equitable right*, something which equity jurisprudence does not recognize. The principle only requires the plaintiff to do 'equty.' According to its true meaning, therefore, the terms imposed upon the plaintiff, as the condition of his obtaining the relief, must consist of the awarding or securing to the defendant something to which he is justly

entitled by the priciples and doctrines of equity, although not perhaps by those of the common law,—something over which he has a distinctively equitable right" (Sec. 386).

"Finally, the principle will not apply so as to compel the plaintiff to do equity, where the relief sought by the plaintiff, and the equitable right or relief secured or awarded to the defendant, belong to or grow out of two entirely separate and distinct matters. The true meaning of the rule in this respect is, that the equitable right or relief secured to or conferred upon the defendant must be something connected with the subject-matter of the very suit or controversy for the proper decision of which the principle is invoked" (Sec. 387).

To the same effect see: Vol. 1, *Story's Eq. Jur.* (14th Ed.), Secs. 72, 75.

Beach states the rule as follows:

"It embraces and applies *only to the one matter* which is the subject of the suit, and not to distinct transactions having no proper relation to nor connection with the subject-matter thereof. And its application does not depend upon the arbitrary notions of the Chancellor concerning the equities between the parties; and the equity of the plaintiff cannot be defeated because he is under some imperfect obligation of a merely moral character, which never has ripened and never could ripen into an enforceable legal or equitable right. And with the exception of a few special cases, the plaintiff cannot be compelled, as the price of the relief demanded, to surrender to the defendant something which the latter could not have compelled by some proceeding either at law or in equity."

Vol 1, *Beach Mod. Eq. Jur.*, Sec. 14.

Second: Equitable relief may fairly be conditioned on something which it is within a party's power to perform but clearly cannot be conditioned where the fact is otherwise.

The project as now proposed by Minnesota is one nec-

essarily contemplating the co-operation of three states, only two of which are parties to this cause. One of these states (South Dakota) has made claims, similar to those of complainant, against Minnesota in an independent cause pending in this court.

The rights of the respective complainant states in these proceedings are wholly independent, and, as affecting separate states, have nothing in common. To make the right of either to relief depend on something which the other should or should not do, would obviously make the relief as to each state dependent on conditions over which it had no control.

For purposes of argument let it be assumed the court should conclude that the project as here propounded by Minnesota for general flood relief in the three states was feasible and practicable. Let it further be assumed that the decree recited the details of that project, to be followed in its installation, and prescribed the basis of apportioning the expense amongst the several states concerned. Let it be further assumed that the decree provided in substance that if Minnesota assented to this plan, it should be accepted by the respective complainants in lieu of injunctive relief. Otherwise expressed, that the relief of the complainants to which they were respectively shown to be entitled should be conditioned on their acceptance of this project, the acceptance of which was enjoined on Minnesota as the alternative or substitute for an injunction.

It will be self-evident that either of the complainant states in the exercise of its independent discretion might decline to accept the project and thus waive its right to ultimate injunctive relief. Neither complainant could force its policies on the other or in anywise control the action

or decision of the other. The resulting contingency might therefore arise that one of such complainants would accept while the other declined the project, thus depriving the former of its right to relief by reasons of conditions over which it had no control.

If, in answer to these suggestions, it shall be contended they are wholly speculative and conjectural, the reply is at once seen in the circumstance, first, that we are dealing with a general principle of equity, in asserting that a complainant's relief should never be conditioned, on something it may be impossible for him to perform, and second, that the speculative and conjectural possibilities, in themselves, are sufficient to establish that nothing of this kind should be permitted, which might jeopardize the entire legal force and effect of a decree.

The vice of the resulting situation, considered from the standpoint of principle, would be in no wise relieved if similar decrees were rendered in the suit of each of the complainant states referred to. The rights of each complainant would or might be thus conditioned on the voluntary act of the other, which neither could control. Otherwise, the result could not be justified, except upon the assumption of the probabilities of each complainant accepting the decree. Such a result would be tantamount to coercing an agreement between the states, which as already shown, is something wholly foreign to the jurisdiction of this court.

In conclusion on this phase, it is contended by complainant that the cause as now presented must be considered independently and as limited to the respective rights and obligations of the states immediately concerned. That the equities which may be considered as pertinent to the determination of those rights and obligations are necessarily

limited to those concerning the parties alone.

That any condition in the ultimate decree beyond complainant's control and impossible for it to perform, is not only not within the equities as thus limited but equivalent to a denial of relief.

(c) *The Project Propounded by Minnesota is not Directed at Remedying the Trespass Complained of. The Plan Itself as Disclosed by the Record is a Mere Generalization and Wholly Insufficient to be Made the Basis of a Judicial Decree. The Objective of the Plan is to Enable Minnesota to Escape all Liability for Reparation.*

1. If the facts here disclosed (which they do not) that the only alternative for safeguarding future repetitions of the wrongs complained of, required at the hands of Minnesota something wholly disproportionate to the wrongs intended to be remedied and which, if resorted to, would confer benefits exceeding the rectification of such wrongs, a more plausible argument on the equities might be presented. Even in the case supposed, however, the subject might be resolved on consideration that the results were inevitable consequences and that the option rested with the wrongdoer to accept the injunction or afford the substituted relief. This feature, however, need not be discussed, as a substitute remedy has been proposed by complainant, limited to restraining the unlawful consequences from the operation of the agencies here complained of.

2. If all the several objections thus considered to the project as proposed by Minnesota be eliminated, a seemingly conclusive answer to its adoption in this case will be seen in its indefiniteness and utter lack of those details essential to a judicial decree.

Minnesota has contented herself with outlining in general terms a project calculated to afford flood relief in the area affected. The general features of this proposal have already been adverted to.

The whole matter, as thus submitted, evidently presupposes the essential features of the plan will be referred to some other tribunal (what such tribunal may be is not disclosed) than the court. Her experts estimate generally that approximately 18,000 acres in the watershed are subject to overflow and would be materially benefited. Of this total, 12,000 acres are located in North Dakota, 3,000 in Minnesota, and 3,000 in South Dakota (Rec. p. 41).

In addition, they estimate about 25,000 acres would be afforded drainage facilities. Of this total, 19,000 acres are located in North Dakota, 6,000 acres in Minnesota, and none in South Dakota (Rec. p. 41).

Apportioning the expense on the basis of the benefits, the overflowed lands would be assessed approximately $15.00 an acre and the remaining area $5.00 an acre (Rec. p. 41).

This, with certain assumed benefits to railroads, highways, municipalities, etc., the assessment of which might aggregate from $50,000 to $75,000, is contemplated to provide the cost of the installation (Rec. p. 42).

It is self-evident on the most superficial consideration that such details are wholly insufficient to provide any definite basis for a decree.

The conditions and contingencies, attendant upon any such undertaking, are so numerous as to immediately suggest that the feasibility, as well as justice, of any such undertaking, could only be determined as a result of the most detailed examination.

The apportionment of the cost would hardly be rested on any such casual estimates with no showing of the basis on which those estimates were reached. Taking the testimony in its entirety, it is self-evident that it amounts to nothing more than broad generalizations, lacking in those substantive and necessary details required as the basis of a decree. The testimony in these respects discloses what has been self-evident from the matter's inception, viz.: that Minnesota does not regard this as a justiciable controversy, to be settled by a judicial decree, but one in which the court will delegate the performance of its functions to certain agencies of the states concerned.

3. Attention has already been directed to the fact the project proposed by Minnesota excludes all consideration of the wrong with which she is charged in this case, as well as responsibility for making amends for that wrong. The resultant situation presents the clearest illustration of what, in the vernacular, is termed camouflage. The case is treated as though no issuable controversy was presented and the sole questions had to deal with matters of general policy or expediency affecting several different states. It is assumed that because complainant and Minnesota have both sustained damage from flood conditions, complainant should readily accede to any plan calculated to effect relief and that failing in this, complainant will, perforce, appear in an unfavorable light before the court. This, in its last analysis, is the assumed equity, the denial of which on complainant's part must necessarily remove it beyond the pale. Such contentions might be more plausible if the underlying motive were not so clearly apparent. If any assumed equity could be worked out of the matters suggested by Minnesota, it could only be on the basis that

after making adequate reparation for the damages resulting from the trespass, Minnesota should first contribute to the cost of the project such an amount as would cover the expense of restoring the natural status and safeguarding future trespasses from the conditions of her own voluntary creation.

Thus, it having been shown that the cost of equalizing and off-setting the excess floods would amount to something in excess of $100,000, this sum should be made a fixed charge against Minnesota, even upon her own theory of the equities of the case. Anything less than this would be a travesty.

Even with this concession, the results would be little more than a make-shift and an ultimate decree fixing this primary responsibility on Minnesota would still be objectionable on the several grounds to which attention has been already directed.

II.

The Only Alternative to an Injunctive Decree is That Which Will Safeguard Future Repetitions of the Trespass Complained of.

Complainant's Project.

For reasons already indicated, the necessity of argument on this phase is largely precluded. If complainant's theory of the law is sustained and it be held the only alternative to an injunction is compliance with requirements safeguarding future repetitions of the wrong complained of, the facts present no substantial issue.

Complainant's project was limited to the accomplishment of the single objective purpose thus indicated. In

considering the details, it may save the time of the court if the matter be presented in the form of an abstract of the testimony of F. C. Shenehon, complainant's principal expert.

ABSTRACT OF TESTIMONY.

(Reference to top paging printed record.)

Direct Examination.

In my opinion, the first project (a), suggested in the court's questions is physically practical but not financially feasible. It creates a detention basin when Lake Traverse already serves this purpose in caring for the excess floods due to the ditching (p. 3).

Creating detaining basins in the Mustinka watershed would entail a large sacrifice of good farming lands (p. 3).

Draining Lake Traverse into Big Stone Lake as suggested in project (d) would impose an additional burden on that lake and the Minnesota River which already have flood problems of their own (p. 3).

Diverting the flow from the Mustinka into the Rabbit River as suggested in project (e) is physically possible but wrong in principle, imposing as it would, an excess flood burden upon the Red River of the North. It would make the Rabbit River fulfill the function of a detention basin which we have now in Lake Traverse (p. 4).

In answering all these questions, I assume we are dealing with the excess flood waters as defined in this case. I have not gone into the matter of lands which might be flooded from other causes (p. 4).

A sluice dam at the outlet of Lake Traverse would solve the problem so far as North Dakota is concerned but would result in flooding a very large area tributary to the lake (p. 4).

The combination of improvement of the channel of the Bois de Sioux River with the dam and sluice-way at the outlet of the lake as suggested in project (c), is the best method of getting the additional detention basin capacity in the lake. Its effect will be to take the water from the bottom instead of the top. If you simply build a dam de-

pending on the natural channel capacity of the river, the result will be that you would merely raise the elevation of the lake artificially. The proposition as I see it is to lower the lake by artificially deepening the outlet channel so that in times of flood you will have the margin of capacity which will safe-guard the lake against a stage in excess of that which would exist under natural conditions (p. 5).

I have had somewhat similar problems in my capacity as Consulting Engineer for the Sanitary District of Chicago in dealing with the Great Lakes. The problem here is one of restoring lake levels due to the lowering caused by an independent outlet (p. 5).

In Lake Erie, in particular, and also in Lake Ontario, I found it desirable to raise the lake to a stage, which under natural conditions of out-flow with no artificial detaining capacity, would endanger riparian lands. The principle I am speaking of here, applied there (pp. 5, 6).

In the case of Lake Traverse, the regulated outlet permits drawing the level down and provides detention basin capacity (p. 6).

My work in investigating the same problems as applied to the Great Lakes commenced back in 1898 while I was connected with the Engineering Department of the Federal Government and these problems have been very much in my mind in the intervening years (p. 6).

In this case my studies have been directed to caring for the excess flood waters alone which come from the Mustinka River so that Lake Traverse will have no superburden. I have attacked the problem on the theory that the floods which will manifest themselves in Lake Traverse and the Bois de Sioux River after the construction which I propose, will be such as would obtain in a state of nature and that the excess flood waters alone are to be taken care of. By the excess, I mean that which results from the ditch construction in Minnesota (p. 6).

In preparing my data, I have employed maps, Exhibits A-1, A-2, A-3 and A-4, which are included in Bulletin No. 1017 of the United States Department of Agriculture. These have been used for the purpose of securing distances, directions and elevations of ground surfaces and the bottom of the natural channel of the Bois de Sioux River and of Lake Traverse (p. 7).

The most feasible and practical method of protecting

North Dakota against what I have termed the excess flow, is the construction of an earth dam crossing the valley east and west, four miles south of the White Rock road at the same point designated for the similar purpose in the above bulletin (p. 8).

I assumed the elevation of this dyke as 978 with top width of 10 feet and with control sluices in the river channel. Two such sluices, each 10 feet in width controlled by movable gates with bottom elevation of 964 are provided. East of the sluices, the dyke elevation is 976 and in time of excess, this will furnish a spill-way. The dyke may be constructed on the ground surface with little stripping and keying. The ground surface elevations vary from 975 to 972.7 indicating the dyke is not required to be of great height. Where the ground level is 975, there will be a three foot fill. As it is not contemplated the water will often exceed the level of 976, the height of the water against the dyke is inconsiderable. The dyke, including the control works, is about 11,500 feet long (p. 8).

From the control works, the river channel is excavated with bottom width of 12 feet and bottom elevation at the control works of 964. The down-stream slope is one foot in 20,000. This channel is widened at the control works from 12 to 25 feet to span two 10 foot sluices and a five foot central pier. From White Rock, the elevation has a bottom width of 10 feet, the same slope and extends 50,000 feet (p. 8).

Exhibits A-5 and A-6 are diagrams of the proposed work showing an 8 foot cut above and a 6 foot cut below or down-stream from White Rock. This channel might be constructed entirely on the Minnesota side. They show a berm of 10 feet for the spoil bank which are not continuous but provided on alternate sides, thus avoiding interruption of the flow on either side toward the main channel (p. 9).

The water surface on the diagram corresponds to 971 at White Rock with a gradient of a quarter of a foot to the mile and a water area for the upper channel of 160 square feet (p. 9).

In the upper drawing of Exhibit "A," the tabulation shows open season capacity; that is, when the channel is not obstructed by ice; also, the surface elevations at the control works and White Rock indicating a slight drop (p. 9).

These tabulations also show the discharge capacity at the control works at different assumed levels for the water in Lake Traverse, as follows (p. 10):

Lake Level	*Discharge—Second Feet*
974	276 plus
973	218
972	163

The lower half of the diagram shows a similar tabulation at White Rock (p. 10).

Water Level	*Discharge—Second Feet*
973	252
972	201
971	155

The water surface illustrated on the diagram corresponds with 971 at White Rock, as stated, and the water area is shown as 140 square feet (p. 10).

Diagram Exhibit A-6 shows in the upper drawing a cross-section of the ditch. There also appears what is marked "Equalizing Ditch to Connect Mud Lake with the Bois de Sioux River" which is also indicated "borrow-pit ditch." This last permits access by small boat and at the same time supplies the material for the dyke (p. 10).

During much of the time there would be no water against the dyke which will thus become grass grown and afford some protection against wave action. The base of the ground on which the dyke is placed should be turned over and stripped and in certain sections it may be necessary to provide a key-way to connect with the solid boulder floor of glacial drift (p. 11).

This dyke will differ from earth dams in general in that, in flood periods when the water is to be released, there will be no great difference in the water level on the up-stream and down-stream sides (p. 11).

The lower diagram on this exhibit contains a section of the control—a concrete structure with two side walls and a central pier with an elevation of 976. I have not attempted to show construction details but have gone far enough to permit a tentative estimate of costs. The floor slab is three feet thick with a cut-off wall at each end three feet deeper. The floor would be perforated on the down-stream side to avoid uplift from water flowing underneath (p. 11).

I have used a simple form of skeleton mitering gate. When it is desirable to open or close these, locks of simple

construction are placed, leaving only the skeleton to be operated and providing for the passage of boats without interruption (p. 11).

My estimates of construction cost are: Channel above White Rock, 121,000 cubic yards @ 25c, $30,000, with an allowance of $5,000 for extras. This last provides for some excess elevation and keying; channel below White Rock 128,000 cubic yards, $32,000 with allowance of $5,000 for extras, the dyke, 36,000 yards @ 40c with $3,000 for extras, $18,000; Control Works, $10,000; total $100,000 with allowance of $10,000 for engineering contingencies, making the whole cost $110,000 (p. 12).

The control of the gates will be manual; that is, they are to be opened and closed according to the program for their operation or one sluice may be opened and the other closed (p. 12).

My former testimony indicated that Lake Traverse at flood level had an area of about 30 square miles; and that it had a somewhat higher elevation to start with owing to the greater inflow from the ditching system. I am not certain whether I estimated 9 or 10 inches as the result of the excess flow in the lake during the flood of 1916 (p. 12).

When the lake is low it has an area of 20 square miles (p. 12).

My plan contemplates drawing the lake down during the months of November and December to 971 or 972. Taking 972, that would be brought about by January 1st by the additional outlet capacity provided. The winter flow owing to ice conditions will be negligible (p. 12).

This will not interfere with the lake during the period of navigation. Until heavy ice forms we have a good outflow capacity. When the spring break-up comes in March and April, the lake will have from 12 to 18 inches to receive the flood waters and we could get by such a flood as that of April, 1916. In fact, 9 inches would care for the 1916 flood (p. 13).

Handling the outflow in March and April will be a matter of judgment. Even the volume which, under natural conditions, might cause some flooding of the Bois de Sioux lands, would cause less flooding because the new channel will be more effective. After the flood waters have passed, the new ditch will have value to drain out the land more

rapidly (p. 13).

During the spring months the lake can be raised from 973 to 974 so that navigation will not be adversely affected. This last suggestion refers to springs of deficient run-off (p. 13).

The scheme has in mind the possibility of a June flood but these last, as a rule, in number of cubic feet to be accommodated, are less in this region than the spring flood (p. 13).

The plan contemplates the possibility of raising the lake to 976 when conditions demand. It does not contemplate safeguarding North Dakota lands against the natural flood except as that may incidentally result from the installation of the proposed works (p. 13).

The records disclose that under natural conditions Lake Traverse has reached a level of 977. The project which I have proposed is not intended to safeguard against natural conditions but merely against the excess flow of 9 or 10 inches above that which would come into the lake under such natural conditions. There has been no intention to work out a flood relief project to better the natural state of affairs except as I have said that you cannot accomplish [illegible]former result without incidentally causing some benefi[illegible] p. 14).

[illegible]nder the present natural conditions there is no appr[illegible]ciable outflow from the lake when its elevation is 972.75 (p. 14).

The proposed construction will permit drawing the lake to a lower level, thus increasing its capacity as a detaining basin over what it would have under natural conditions by the amount to which its levels have been artificially lowered (p. 15).

In my judgment this plan will undo any damage to North Dakota lands which is charged in this case (p. 15).

Cross Examination.

I have given very little consideration to Bulletin No. 1017 (p. 15).

In my previous testimony I stated there would have been a decided flood in Lake Traverse in April, 1916, but that that flood was from 6 to 10 inches above what it would have been in the absence of the ditching (p. 16).

I do not recall the area of the lands in North Dakota which the original testimony showed was flooded. I as-

sumed that part of the case was closed and that we were now dealing with remedial measures (p. 16).

I have not assumed any particular acreage as entering into the case at the present time but have presented a remedial measure to eliminate any danger to the lands in the Bois de Sioux valley by taking care of the excess flow shown in the previous record (p. 16).

Any damage coming from the excess flow from the Mustinka watershed is taken care of in Lake Traverse. I have not refreshed my memory with the details of the previous record. What I now aim at, is to make Lake Traverse sufficient to take care of the excess discharge and with this we have undone the damage in the Bois de Sioux valley (pp. 16, 17).

I have proposed remedying any damage shown in the previous record so far as North Dakota is concerned. The portion of the floods which will now be cared for is disclosed in the former testimony (p. 17).

We are presenting a remedy which will bring about a return of the natural conditions so far as damages are disclosed to the lands in 1916. That is, I have proposed a method of absorbing the excess waters growing out of the ditching system in Minnesota and there is no necessity of my going down the Bois de Sioux River and talking about Dakota land. Your questions are opening the subject of danger. The Supreme Court called for a remedy (p. 17).

You have this excess coming from the ditching system which was shown in the previous record. That is the positive thing. I have supplied the negative thing to off-set that in Lake Traverse (p. 18).

Any portion of the North Dakota area shown in the original record to have been covered by the excess flood waters will be protected under the present plan. For the precise portion, you will have to see the record. I do not care to answer the question (p. 18).

The project I had suggested contemplates protecting North Dakota from such floods as occurred in 1915 and 1916, to the extent those floods were caused by the excess waters (p. 18).

When such a flood as 1916 comes along under the present project, Lake Traverse will be at a level of from 971 to 972. This makes a receptacle which will absorb the excess water so that any water discharged from the lake will be only

that which would have been discharged under natural conditions without any ditching in Minnesota (p. 18).

Floods of the intensity of those of 1915—and 1916 should be looked for oftener than once in 10 years but I have not gone into this feature in detail, confining myself solely to the remedy (p. 19).

Re-Direct Examination.

The project which I have proposed is one of flood control only so far as pertains to that portion of the flood which is excess over what it would have been in a state of nature owing to the ditching operations in the Mustinka watershed. I have assumed the natural conditions will remain in the future as they have been in the past. The betterment proposed by this project is the removal from the Bois de Sioux lands of the super-burden imposed by the Minnesota ditches (p. 19).

The project will effect no change so far as the natural phenomena are concerned except as it changes the elevation in Lake Traverse to make it a better detaining basin. I have not aimed to control or prevent floods that have come in the past and will come in the future as the result of natural conditions alone. My sole problem has involved the protection of the Bois de Sioux lands against the excess flood waters resulting from the artificial ditching in Minnesota (pp. 19, 20).

The conclusions indicated in the foregoing are fully confirmed by the testimony of Professor E. F. Chandler which for convenience may be similarly reviewed in brief abstract form.

The natural and logical remedy (for the excess flood) is dredging the channel of the river, but this, if not coupled with some detention of the flood crest in the lake would be expensive. It would also impose a super-burden further down the Red River. Moreover, if the levels in Lake Traverse were not preserved by sluice gates, the necessary effect of increasing the outlet would be to draw the lake's level down to a point interferring with navigation. By a dyke and sluice gates, the matter may be handled so that the lake's level may be preserved and yet make it possible to draw the lake down to ordinary low stages previous to

each flood season, even after a series of wet years (p. 22).

The lake would thus have sufficient capacity as a detaining basin to hold for a few weeks or for a few months the "top of the flood," that is, the excess portion which works the most injury of any part,—to hold it temporarily and discharge it down the river after the flood period had passed (p. 22).

I have examined the engineering data submitted by Professor Shenehon and checked his computation. I had previously prepared a substantially similar plan. His plan is a complete remedy for the artificial changes in the conditions of Lake Traverse and the Bois de Sioux River obtaining as a result of the Minnesota ditches (p. 23).

The plan works thus: By dredging the river, its discharge capacity is increased so that at extremely low stages it will carry about 150 second feet and at ordinary high stages an excess of from 200 to 300 second feet. It will be possible and simple late in each fall at the close of navigation to begin to draw the lake down. In a wet season this could be started earlier. By the middle of the winter, even in the wettest season, the lake can be lowered to 972 or below (p. 23).

Closing the gates in the spring will permit raising the lake's level from 972 (the stage required for navigation) to 974. If the previous fall had been very wet or the winter one of heavy snow resulting in excessive run-off, the gates may be kept open, thus affording an increased discharge of from 200 to 300 second feet through the increased outlet. When the flood arrived, the lake would thus have an additional storage capacity of some two feet (p. 23).

In this method the stage could be maintained at 974 (the approximate normal) without difficulty and if a summer flood came, this could still be held in the lake, at least to the extent of the assumed excess inflow caused by the ditching and be gradually discharged (p. 23).

The lake would thus act as an equalizing basis. With the excess channel capacity of the river and the increased detaining capacity of the lake, the latter from one to two feet, the excess inflow from the ditching would be cared for (p. 24).

Under this plan, the lake level may be maintained between 972 and 975 except in abnormal seasons when those levels would have been exceeded under natural conditions (p. 24).

This plan will have no appreciable effect on natural flood conditions except in so far as the results of its operations increase the storage capacity of the lake. The latter increased capacity will be sufficient to safeguard the excess inflow resulting from the ditches (p. 24).

Where floods would have existed under natural conditions, they will exist to substantially the same extent with the improvements as now proposed. These have been aimed exclusively at safeguarding the excess floods due to the ditching, which, as I recall the previous testimony, resulted in raising the level of the lake about one foot and the level of the river at the lower point of the valley, about two feet (pp. 24, 25).

The matters covered in the foregoing abstracts, taken in connection with the diagrams, Exhibits A-5 and A-6 (Rec. pp. 104, 105), render further detailed explanation unnecessary.

In principle, as already stated, the project thus proposed is the same as that covered by the Simons report, *supra* (Bulletin 1017), and by Minnesota's experts. The objective purpose in all is similar. The differences have exclusive reference to the ultimate results sought to be accomplished—on the one hand, the safeguarding of what the witnesses have referred to as the *excess floods* due to the ditching and on the other hand, safeguarding *all floods* regardless of their causes or origin. The magnitude, in construction detail, of the Simons project exceeds the others but the differences are assignable to the broader objectives contemplated. The essential thing from the standpoint of present purposes is the identity in principle of all of these projects.

All accept as the essential starting point, increasing the reservoir storage capacity of Lake Traverse. As necessarily incidental to this purpose, all contemplate dredging

the Bois de Sioux channel to permit regulating the lake level and provide additional discharge capacity in flood periods.

With the basic principles thus conceded, the controversy resolves itself on determining the objectives sought to be accomplished rather than the means of their accomplishment.

With respect to the latter, complainant has limited itself to a project calculated to off-set and equalize the injurious consequences forming the basis of its complaint. The results aimed at are the same as would have been effected by the construction of detaining basins in the Mustinka watershed, for which the proposed project is substituted as more practical and economical as well as equally efficacious, in accomplishing the same objective purpose.

With the elimination of detaining basins in the Mustinka watershed (project (a) in the court's order), and diversion of the flood waters from that watershed through the Rabbit River (project (e) in the order), Minnesota has eliminated from consideration the only results to which either of those projects could be assigned or with respect to which either thereof could function, from the case, and substituted the subject of general flood relief.

As a necessary consequence of this substitution, the plan proposed by Minnesota assumes greater proportions and the agencies for its accomplishment, greater magnitude.

Conceiving that such substitution wholly misconceives the purposes to which the court's order was addressed and involves purely extraneous matters, complainant has made no issue with respect thereto in the facts and for similar reasons, excludes their consideration in this argument.

III.

Minnesota's Objections to Complainant's Project.

Under this heading the matters to be considered will have exclusive reference to objections addressed to the physical or engineering features.

At the outset it should be noted complainant makes no claim for the adequacy of its project as one of general flood relief, hence, criticism postulated of its inadequacy for such purpose is of no pertinency. We have therefore, only to deal with the criticisms of its *practicability and efficiency for the purposes for which it is intended.*

As stated *supra,* these criticisms turn on two main points, viz.: (1) that the plan in its general design is on too limited a scale, and (2) that its completion would prove an obstruction to broader projects of general flood relief. The answer to these is quite obvious. If Minnesota conceives the success of the plan depends on increasing its scale, there is nothing to prevent an increase without the slightest variation in principle.

Complainant has worked out, as a result of careful study and investigation, that which it believes will effectually safeguard its rights and prevent repetitions in the future of wrongs similar to those perpetrated in 1915 and 1916.

The factors considered in reaching this result are those disclosed as existing at the time stated, as well as the period covered by the taking of the original testimony in this cause.

Complainant's purpose has been to treat the problem fairly and without exaggeration of its incidental details. It has sought to avoid magnifying possible consequences,

the necessary result of which would inflict unnecessary cost and expense on Minnesota.

In pursuing this policy, there has been throughout the possibility of error on the side of conservatism and that due regard for what might be reasonably considered the factors of safety might have fully justified enlarging the project's scale.

Furthermore, complainant has, perforce, been compelled to recognize the possible contingency of Minnesota's having other and further schemes of artificial drainage in contemplation, which, if constructed and made operative in the Lake Traverse basin, might render the presently proposed project inadequate. Such matters, however, could not be legitimately injected in the present controversy.

The possibility of some such matters as those last suggested may explain Minnesota's attitude and account for the criticisms under consideration.

The answer however, is quite apparent. With the law establishing the respective rights of the parties settled,—necessarily including the limitations on the respective rights of user of boundary streams,—and with the rule promulgated that neither party may relieve itself of its own flood burdens by casting such burdens on its neighbor, incidentally including the consequences of such acts, if perpetrated, it only remains to provide the means of preserving the natural status.

If Minnesota is convinced (as is fairly inferable from her present position) the natural status cannot be preserved by the agencies proposed by complainant, at least, without increasing the scale of those agencies, complainant cordially accedes to this view and consents that the structures contemplated may be increased to such magni-

:nde as Minnesota may deem necessary (at her expense) with the proviso that the principle of design is not changed and that no unreasonable extension of time, within which the work is to be completed, is granted.

The incidental criticisms directed to the engineering features as well as those suggesting that the proposed construction might obstruct a greater flood relief project are largely trivial.

Possibly the best answer may be made by appending a brief abstract of the testimony of complainant's expert, Shenehon, on rebuttal.

Referring to the criticism by Minnesota's experts of the project of Professor Chandler and myself, attention may be directed to the fact that the dyke as proposed by them has an elevation of 978 which is the same as that shown by us on Exhibit A-6 (p. 92).

Under flood conditions such as those in 1916, the water elevation might be 976, thus allowing 2 feet of free-board (p. 92).

It was, of course, assumed the dyke would be maintained and not be permitted to disintegrate or go to pieces any more than any other dyke (p. 92).

While there may be some sweep of wave action, the waves, for the most part, would come over shallow ground, impeded by weeds and the situation, so far as over-wash is concerned, would be similar to that of 1916 when the water passed over the White Rock road which forms a cross valley dyke. The difference would be that in the latter case the water was at or above the road level while here it would be 2 feet below (p. 92).

Misunderstanding of the capacity of the sluice-ways enters into the criticism of the dyke elevation. With a water level of 976, two feet below the top of the dyke, the cross-sectional area of the sluice-ways is 240 feet. If there is a drop of 1 foot through the sluice-ways, the discharge would be 1,400 feet (p. 92).

I cannot conceive under such conditions as obtained in 1916, of a very large outflow through the sluices. This

would be the natural flow less the amount we have charged to the excess. At 976 the outflow will be less than we had at 977 in 1916 (p. 92).

Professor Meyer indicated the capacity of the sluices at 400 feet. At 976, this would indicate a velocity of 1.7. The difference between the eelvation above and below the dyke would be about ¾ of an inch. This is merely suggested to emphasize that we are not dealing with conditions of ponded water at an elevation considerably higher than that of the outlet (p. 92).

There is no occasion for creating additional spill-way capacity. When the sluices are operating at their maximum capacity, or between 1,000 and 1,400 feet, the downstream channel simply cannot carry the water away. The sluices therefore are not the only retarding effect. If I had enlarged the river channel with a view to general flood prevention rather than the limited remedial project proposed, some small menace might appear. The suggestion, however, is somewhat trivial as the height of the embankment (dyke) may be increased. I allowed a little leeway in my estimate for extras to cover this latter possibility. Actual field examination might indicate reasons for making small changes. We are stating principles, however, rather than ultimate conclusions (pp. 92, 93).

The criticism that under our project the waste banks from the dredging of the river channel would prove obstructions to the natural drainage similarly appears a little trivial. I am assuming engineering good sense would prevail in a work of this kind and the spoil would be placed where it would do the least damage. If a 10 foot berm is not enough, use 20. I see no value in such a criticism (p. 93).

On Exhibit A-5 we have indicated the spoil banks are not to be continuous but on alternate sides. This indicates placing the spoil where it will have the least obstructive effect (p. 93).

As to the claim the project proposed by us would interfere with the larger undertaking mentioned in Bulletin 1017, my reply is this: The project in the Bulletin contemplates general flood relief in the Red River of the North. It is taken up in three sections or parts; that relating to the Bois de Sioux shows the author employs a

cross-valley dyke located at the same point where the witnesses for Minnesota and we ourselves locate it. It increases the proposed elevation to 983 and contemplates a levee between Lake Traverse and Big Stone Lake, thus greatly increasing the reservoir capacity in Lake Traverse (p. 94).

All these projects have central control works in the dyke coupled with dredging the river above and below. The larger projects would take a longer time, both in the preliminaries and execution. They handle the spill-way a little differently from the method proposed by Professor Chandler and myself (p. 94).

The proposal of Minnesota's experts reduces the project in the Bulletin to a small scale but would require two or more years for construction and cost very much more than the project proposed by us (p. 94).

The dyke, as proposed by us, when completed, could be used as a part of a larger project. I have already indicated the outflow capacity of the sluices planned by us. If Minnesota wishes to place more units, any increased spill-way or outflow capacity may be obtained which is desirable. As to the channel excavation, the work which we have proposed would be so much toward the larger project. If the latter were undertaken, it would envelop and utilize the lesser as planned by us (p. 95).

In conclusion on this phase of the case, we can only repeat what was stated in substance in the statement *supra*. If the interpretation of complainant of the scope and purpose of the court's order is correct, there is no substantial controversy between the parties on the record as now finally submitted.

IV.

Matters Urged by Minnesota Outside the Scope of the Questions Submitted and Directed at Reopening Issues Concluded by the Original Testimony.

Substantially a year was covered in taking the original testimony in this case. The evidence comprised four volumes of printed matter, exclusive of a vast amount of data introduced as exhibits which were not included in the printed record. Each party was afforded the most ample opportunity of developing every phase of the case deemed by it material to the full presentation of the issues. Neither in the briefs as originally filed nor on the oral arguments submitted to the court was any suggestion made that either side deemed further proofs necessary or desirable for the final solution of the questions submitted. While the details covered a wide range, all, in their last analysis, came back to the single question, viz.: the responsibility of the artificial construction by Minnesota for the floods and resulting trespass complained of. This necessarily involved consideration of the whole subject of run-off from the watershed in question, as affected by the ditch construction and to this single and vital issue, the evidence and data finally submitted to the court was directed.

The court's order directing the taking of additional proofs indicated the special subjects to which those proofs should be addressed. Those subjects obviously embraced matters not covered by the evidence as originally taken, with respect to which the court deemed information essential to the final disposition of the case. Nothing in the

order indicated any other purpose than as thus stated or suggested that subjects concluded by the original proofs were to be reopened for further investigation. Notwithstanding, Minnesota has made the privilege extended by the order an excuse for reopening issues previously concluded by the final submission and presenting extended additional testimony thereon.

But for the detail with which the matters thus referred to were presented by Minnesota in the additional proofs and the danger that failure to challenge might be construed as a tacit concession of their correctness, no reference thereto would be made in this argument.

Complainant, as already stated, contented itself with reserving its objection to the proofs thus indicated, but the testimony was taken and has been returned in the record now submitted.

1. Summarized, the propositions now advanced by Minnesota are as follows, viz.: (1) The ditch construction in the Mustinka watershed had no effect on the run-off of that area other than as accelerating the discharge of the accumulated waters by approximately two days; (2) the run-off of the watershed was not increased by such construction; and (3) the acceleration of discharge and increased volume thereof into Lake Traverse, lowered instead of raised its flood levels.

In support of these several contentions, various hydrographs, isohyetal maps, tabulations of precipitation and run-off have been introduced.

It is not deemed necessary, however, to consider these in any detail.

It is apparent that argument of these subjects would require retraversing substantially the entire ground cov-

ered in complainant's original brief in this case. There is believed to be no justification for an imposition of this character on either court or counsel.

Allusion to anything more than certain salient features with incidental references to Government Bulletin 1017 is seemingly all that is required under the circumstances.

At the outset, in the introduction of this testimony, it is quite evident counsel have wholly overlooked the answer filed on Minnesota's behalf in this cause. For their enlightenment and the court's convenience, the following excerpts from the answer are appended:

> "That in conformity to the provisions of the act of the legislature * * * and for the purpose of improving the public health of the people living in the low land drained and about to be drained by the construction of a ditch along the general line and direction of the Mustinka River, such ditch was built. * * * The defendant admits that the new and artificial channel superseded the previously existing natural channel" (Par. XV, Original Record 25).
>
> "That as a result of such drainage hundreds of farms have been benefited and thousands of acres rendered dry and tillable, beneath the surface of which land the water-table was, during the growing season before such ditching, only a few inches or at most a foot or two" (Par. XVIII, Original Record 27).
>
> "That the overflow of the Mustinka Delta Zone above described was not sufficient to permanently inundate or saturate the soil, but only to do so in the spring after snow-fall was heavy or at other seasons after unusual rainfall and then only for a relatively short time after the spring freshet was over or the unusual rainfall had ceased" (Par. VIII, Original Record 22).
>
> "That the area prior to the construction of the second Mustinka State Ditch in which waters were accumulated, was less than sixty (60) square miles and said sixty (60) square miles were overflowed only at

times of excessive high water" (Par. XIII, Original Record 24).

"That the waters so cast into said lake and river were accelerated by the ditching projects of the State of Minnesota and its subdivisions and contributed to the water which inundated the lands described in the bill; that said water was collected and cast with greater rapidity and volume into the said lake and river as a result of the necessary drainage of low areas located in the State of Minnesota" (Par. XVIII, Original Record 27).

Notwithstanding the matters just stated, we are now informed that the only effects of this great drainage project inaugurated by Minnesota and her subdivisions at an expense of approximately $1,000,000 was to expedite the drainage of the area by two days over the time consumed for this purpose under natural conditions.

Comment under such circumstances seems superfluous.

It was admitted in the answer, as quoted *supra*, and attested by substantially every witness called by Minnesota on the original hearing, as well as the recitals of the legislative act, *supra*, that what was termed the confluence area (the Delta Zone) was subject to periodic inundation during periods of spring freshets and summer floods.

Had the claim been otherwise, the contrary would have been sufficiently attested by the topographical conditions, coupled with the elaborately constructed drainage system for relieving those conditions.

It is significant in this connection that the investigations in Government Bulletin No. 1017 disclose a total area of low land in Traverse county (with which we are dealing) of 307 square miles, of which total, 184 square

miles, or 60% is within one-half mile of artificially constructed drainage.

See Bulletin, Table 14, p. 57.

It is further significant that the cause of flooding at the confluence was the limited discharge capacity of the natural channel referred to in the original record as "the loop." Also, that the construction of what was termed the "cut-off," substituted for this natural channel, one having approximately one-third the length of the former and somewhat less than double the former's discharge capacity; also, that what was termed the "rectification" or enlargement of the river channel from the mouth of the "cut-off" to the outlet in Lake Traverse, materially increased the discharge capacity of the latter.

These features are mentioned not to indulge in unnecessary repetition of what was fully presented in the original hearing, but merely for effecting a composite picture of the situation, to which novel results are now assigned by Minnesota's experts.

The difficulty with the particular testimony appears in its obvious evasions and its insistence on generalizations of no material moment. We are here dealing exclusively with flood conditions which presuppose and in the light of the facts, necessarily concede the accumulation of vast bodies of water within a given area and where the outlet provided by nature is wholly inadequate for their discharge.

This situation is changed by what for convenience we may term, tapping the reservoir with additional outlets of incalculably greater discharge capacity. We know that under such circumstances during flood periods, both out-

lets are discharging to the maximum and that the resultant volume of such discharge is substantially double. Notwithstanding, we are now confronted with the assertion that such conditions effect no appreciable modification of the discharge or the run-off, which, as applied to flood conditions, means the same thing.

The whole subject thus suggested might be expressed in the inquiry that if drainage does not drain, what function it subserves?

The theories of equalization of flow as a result of artificial open drain construction and increased capacity of soil absorption were refuted in detail in the original hearings.

2. Certain incontestable features pertinent to the matters now suggested are disclosed in the following facts:

The discharge of the accumulated waters of this watershed in flood periods was necessarily limited by the capacity of the loop. This, so to speak, was the "bottle-neck." Estimates of its maximum carrying capacity on the original hearings varied from 1,000 to 1,800 feet. Minnesota's expert placed this figure at 1,500 feet and Professor Chandler, one of the experts for complainant, at slightly over 1,000 feet.

Based on flood levels at the peak of the 1916 flood which were confirmed by actual measurements of Mr. W. R. Powrie, one of the engineers of the Chicago, Milwaukee & St. Paul Railway (Original Record, p. 2093), the discharge at Wheaton was shown to be between 3,500 and 4,000 second feet. The maximum computation was approximately 4,300 feet (Original Record, p. 2113), but the lesser figure may be taken as sufficient for present illustrative purposes.

These computations were confirmed by the results of actual Government readings. It will be recalled in this connection that the Government station was not established at Wheaton until June, 1916, after the flood of that year had passed. The maximum recorded discharge shown by the Government records was April 1st, 1917, 2,240 second feet. The water stage at this time was 12½ feet above low water mark. At the peak of the 1916 flood, the water level was approximately 16 feet above low water mark.

See Chandler, Original Record, p. 549.

See Complainant's Original Brief, p. 70.

The excess height last indicated accounts for the volume of discharge over the maximum disclosed by the Government records.

We thus have a maximum limited by the discharge capacity of the original outlet to 1,500 second feet under natural conditions, contrasted with a maximum of more than double that amount under the artificial conditions.

For all purposes of the present discussion, these matters may be taken as uncontroverted. The conclusions must be deduced accordingly.

In assuming a maximum discharge of 1,500 second feet under natural and 3,500 second feet under the artificial conditions, it must be recalled these figures have reference to the peak and exclude the idea of the continuance of such volume for any definite period of time. The latter may have been an hour or a day. But a more or less indeterminate period necessarily existed during which the flood was rising to and receding from the peak. This period was estimated by Professor Chandler as ten days and the average discharge for the entire period fixed, on the

basis of 3,500 maximum, at 2,500 feet. Professor Chandler's conclusions on this feature stands similarly uncontroverted.

Assuming therefore the natural channel (the loop) might have carried its maximum for the whole ten day period and we still have an excess of a thousand feet or more necessarily ascribable to the artificial outlet. This is the excess that imposed the super-burden resulting in the lake's overflow and the inundation of the Bois de Sioux Valley.

It is a peculiar coincidence that the maximum ascribed in these figures to the natural run-off (limited as that necessarily was by the discharge capacity of the outlet) is in substantial accord with the highest values for run-off in the general region in question by the records of comparable watersheds.

See Chandler, Original Record, pp. 852, 853, Complainant's Original Brief, p. 70.

3. But for the fanciful and impractical theories now for the first time advanced by the experts of Minnesota in the evidence, the resultant conclusions from the matters last stated would appear self-evident. The natural and necessary effect would follow in the light of ordinary every-day observation and experience.

The attendant incidents of floods and freshets (the manifestations of which are scientifically termed run-off) with the rapid increase of water stages and consequent conditions of overflow are noted yearly with the spring breakups, particularly in our northern climes. Temperature and precipitation (warm winds and rains), soil conditions (imperviousness due to the presence of frost), topog-

raphy, proximity and access of surface water to the main discharge channel with other conditions not necessary to be detailed, all have their bearing and contribute to the ultimate phenomena which are matters of ordinary observation.

Open drainage increases the number of discharge outlets, thus facilitating the access of the waters to the ultimate discharge channels.

The Government engineers make the following comments on this feature:

> "The function of artificial drainage is the disposal of excess water. Usually it is essential that such water be removed more quickly than it flows off through the natural channel. This fact in itself would seem to imply an increased run-off rate as a result of artificial drainage. * * * The only important conclusion which has been reached relative to the effect of artificial drainage on run-off is, that when heavy rainfall occurs or when large quantities of snow melt rapidly, artificial drains may operate to increase the rate of run-off when the areas drained are for any reason impervious to water, that is, when the ground is frozen or saturated. *Such increase in rate of run-off will increase flood heights along watercourses of insufficient capacity.*" Bulletin No. 1017, p. 41.

In his text book, Professor Meyers (one of Minnesota's experts) after referring to the effect of tile drainage, says as follows:

> "During torrential summer rains, however, the rate of absorption of water by even the best drained heavy clay soils, is altogether too slow to prevent excessive surface run-off even from flat slopes. Open ditching, under such conditions, *facilitates rapid surface run-off and increases flood flow*" (Italics ours).
>
> *Elements of Hydrology* (Meyer), 1st Ed., p. 283.

Notwithstanding the matters thus indicated would seem

self-evident, we are now met with the astounding contention that the sudden influx of water (the concomitant condition of freshet) into the discharge basins and channels will lower the water levels of the latter below that resulting from similar volume of inflow extended or distributed over considerable periods of time.

See Meyer, Rec. pp. 47, 48.

See Morgan, Rec. p. 82.

There is little wonder that Professor Meyer qualified the general statement indicated, by the announcement even he, himself, had been somewhat confounded at the results of his computations (Rec. p. 62).

That the factors entering into such computation are of necessity arbitrary, theoretical and impracticable is sufficiently attested by the anomalous results of their employment.

Illustrations innumerable might be resorted to in refutation of the absurd hypothesis now propounded but the following will suffice, referring as they do to conditions in the region with which we are dealing.

The Government engineers report a storm (June 20-23, 1919) over Lake Traverse with a resulting precipitation of between 2½ and 4 inches in 48 hours. *This storm raised the lake's level approximately 2 feet.*

Bulletin 1017, p. 33.

The greatest storm recorded in this region was that of July 20-22, 1909, which centered in the watershed area of the Minnesota Wild Rice River. The precipitation for 24 hours was 10.75 inches. The resultant flood run-off far exceeded anything disclosed in the previous records.

Bulletin 1017, p. 33.

The observation of the authors of this bulletin with respect to a relatively large number of storms in this area are recorded at page 30, *et seq.* By comparison of the dates of such storms with the table of maximum recorded run-off (Bulletin, Table 3, p. 20) the relation between excess precipitation in the form of compact storms and maximum flood conditions in the discharge channels is apparent.

Upon the hypothesis now postulated by Minnesota's experts, had this precipitation been extended or distributed over considerable periods of time (the resultant volume being the same), the flood conditions in the latter would have exceeded those resulting from the former.

Such assertions attest the frequently observed obsessions of the methematical mind for the complex and incomprehensible. As a problem for the schoolroom whose objective is the test of mathematical skill, fictitious and improbable factors may have value. But for practical purposes, such criteria are better disregarded.

One of the most familiar and elementary statements dealing with *flood conditions* in general is expressed in substance, to the effect, that while precipitation is the source, the casual connection is found, not in *the volume* but in *the distribution*, a result fully reflected in the testimony in this case and the authorities already cited.

Abstractions such as those now indulged by these experts which alike contradict common observation and common sense, usually find refuge under some indeterminate and arbitrarily assumed factor, difficult of ascertainment, but in reality providing the solution of the riddle. It is surmised (whether correctly or not we do not undertake to say) that factor in the present instance is found in the

words "unlimited out-flow."

Assuming this to be correct, the problem is without materiality or pertinency to the conditions with which we are here called upon to deal.

4. The cross examination of these experts disclosed the most patent evasion as will sufficiently appear from the record where page after page of inquiries was devoted to the attempted elicitation of concrete answers to definite questions.

See Cross Examination Meyer, Rec. pp. 57-61.

The witness Morgan admitted that as applied to Lake Traverse, if the in-flow and out-flow were equal, the lake level would remain stationary (Rec. p. 85).

Following a series of questions and evasive answers, Professor Meyer was asked to assume the case of a lake similarly situated to Lake Traverse with a similar outlet and to further assume 10 inches of precipitation on the lake's surface, this precipitation in one instance in a single day and in another, extended over 10 days and asked what the relative effect of the assumed conditions would be on the lake's level. He replied in substance that there would be a slightly higher level resulting from the single day's precipitation (Rec. p. 60).

This in and of itself is tantamount to a confession of the fallacy of the contrary anomalous theory propounded by him.

The witness Morgan was asked to assume that starting with the elevation of 975, the lake's out-flow was 500 feet and at elevation 976, the out-flow was 700 feet and was then asked to assume that the volume of in-flow which produced these conditions was increased 1,500 feet over a

period of 10 days, what the effect would be on the lake level. After evading by the statement such conditions could not exist in a state of nature, he reluctantly admitted that the lake would be raised approximately 1 foot (Rec. p. 85).

The concessions thus reluctantly drawn from these witnesses destroy any force or effect that might otherwise be ascribed to the fanciful theory propounded by them.

5. It is significant that in all of the variety of theories now advanced by Minnesota's experts, reinforced by tabulated data and computations, no explanation for the floods themselves has been vouchsafed. The conclusions of these witnesses with respect to the casual conditions lacked concrete statement and must be left wholly to the field of inference. No allusion is made to the differing conditions incontestably established for the years 1915 and '16 over those existing in previous years when the meteorological conditions were substantially identical and when no such floods as those of the years indicated manifested themselves. Similarly no allusion is made to the undisputed fact on this record that no such *summer* flood as that of 1915 had previously existed in the Bois de Sioux Valley.

With access to the voluminous data included in the present record as well as that embraced in the reports of the various Government bureaus, the silence of these witnesses with respect to the 1915 flood is one of the most conspicuous features of the case.

If the matters here presented dealt exclusively with the spring flood of 1916, a more plausible argument, assigning the cause of that flood other than to the excess discharge of the Mustinka watershed, might be suggested. But even here, difficulties would be encountered in explain-

ing the wholly different manifestations from those which had existed during spring floods of previous years where the attendant flood features equaled or exceeded the year in question.

The 1915 flood occurred in the summer, long after the attendant incidents of spring break-up had passed. Had the conditions of the previous year (1914) been conducive to floods, the results must have manifested themselves during the spring run-off of the following year (1915). The circumstance that no spring floods occurred in the latter, excludes 1914 from the problem.

The natural conditions of 1915 disclose nothing abnormal. The annual precipitation of that year was below normal and amounted to 23.06 inches. The precipitation of the winter months was necessarily reflected in the spring run-off when no flooding occurred. We are thus brought to consideration of the months of May, June and July, during which the flooding occurred.

By reference to the report of the Government engineers, it will be seen that the aggregate precipitation for these months in 1915 was less than the similar aggregate for the years 1882 and 1905, and that it exceeded that of the years 1901 and 1914 by only a fraction of 1 inch.

See Bulletin 1017, Table 4, p. 31.

Notwithstanding, the Bois de Sioux Valley was flooded during these months and remained flooded throughout the remainder of the year.

Further argument on this phase under such conditions seems wholly unnecessary.

V.

Consideration of the Report of the Government Engineers.

It is not proposed to enter into any detailed review of the report in Bulletin 1017 to which reference has been made at a number of different points in this argument. The report itself is quite voluminous and the data therein of invaluable character, particularly with reference to the precise project therein proposed.

In its broader features, however, it is so clearly confirmatory of the contentions of complainant's experts as to warrant brief reference to certain of its salient features.

At the outset, attention should again be directed to the fact this report addressed itself to flood relief within the entire area tributary to the Red River of the North. Incidentally, the particular features of the more limited area included in the Lake Traverse-Bois de Sioux basin have received separate consideration. Much of the matter contained in the report must be interpreted in the light of the specific object to which it was addressed and many of the estimates are necessarily to be treated as such and as emanating from the purpose of safeguarding the maximum contingencies that might be anticipated.

It will be noted that the exhaustive compilations of the authors covering the run-off of the entire watershed area is shown in tabulated form in Table 4, p. 21, disclosing an annual mesne of 2,881 second feet, which, for the 26,000 (round figures) square miles, discloses substantially .12 cubic feet per square mile. Professor Chandler's estimate of the same matter was .15 cubic feet (Original Record, pp.

544-546—Original Brief, p. 69).

Briefly digressing at this point, attention may be directed to the fact that the run-off from the Mustinka watershed for the year June, 1916, to June, 1917, after the ditching construction was completed, as recorded at the Wheaton station, was 207 second feet (Original Record, p. 546), which, for the 750 square miles of watershed area, would show .27 cubic feet per mile, or, considerably more than double the mesne as determined by the authors of the bulletin.

This showing clearly confirms the statement of complainant's experts to the effect that the volume of discharge from this watershed has been substantially doubled as a result of the ditching. Under flood conditions, the excess might reasonably be expected to manifest a still greater proportion to the natural discharge but this feature need not be further emphasized.

The authors are somewhat non-committal with respect to the effect of open drainage during the time of spring run-offs owing to the congestion of such drains by the presence of snow and ice (p. 42).

For the purpose of this case, it is unnecessary to make issue on these assertions and we content ourselves with the general statements that what is true of the artificial would be equally true of the natural channels; that the presence of ice would largely depend on whether the ditches carried water at the period of freeze-up during the fall, and finally, that the presence of water under the ice would have the same effect in clearing the artificial that it has in the natural channels.

On the general subject of run-off, the report is an amplification in matter of detail of much of the testimony

given by Professor Chandler on complainant's behalf in this case and no purpose would be subserved by reviewing these features in detail. The portion of the report in which the particular phases of this subject in which we are interested occur has already been cited at an earlier point in this argument.

The factor of evaporation and its importance in dealing with the question of run-off is quite fully considered. As the figures included in the report are quite largely those of Professor Chandler (p. 42), the results may be succinctly expressed in the statement of the latter to the effect that of the normal annual precipitation of 24 inches only approximately two inches are comprised in the ultimate run-off (Original Record, p. 546).

The compilations of precipitation and distribution similarly confirm Professor Chandler's testimony in this case.

The importance of this is at once seen in confirming the latter's contentions that nothing in the meteorological conditions of 1915 and 1916, explain the floods complained of or differ materially from the conditions of a series of previous years in which no such floods obtained.

Compare Bulletin Table 4, p. 21, and

Abstract Chandler's Testimony Complainant's Original Brief, 62-64.

The detailed examination in the report of storm distribution has already been referred to and is mainly important as confirming the general statements of complainant's witnesses, of the effects attributable to such storms on flood conditions. As applied to the matters here in issue, these features have no other than general bearing for the reason that upon the facts here presented we have no occasion for dealing with storms of abnormal proportions.

The attendant incidents of such storms in their effects on run-off and water stages in the discharge channels has already been commented on.

The results of the observations of the authors in these respects are fully confirmatory of the testimony of complainant's experts. The authors have made detailed investigation of the recorded run-offs from the entire watershed. For this purpose the entire area is sub-divided into seven separate areas as shown in Figure 5, p. 24. The first of these areas, which includes the Mustinka watershed, embraces 4,225 square miles (Table 7, p. 26).

As the area of the Mustinka watershed is only 750 square miles, it will be observed that general deductions with reference to the former may include conditions having no reference to the latter.

In Table 3, p. 20, the authors tabulate the maximum stream discharges throughout the entire watershed. This table properly understood is similarly corroborative of complainant's experts. In its examination, it must be noted at the outset that it is dealing with the *maximum recorded* discharge. This wholly excludes the element of time (duration of flood flow), indicating only that the meter readings on some particular date disclosed the results indicated. By reference to this table it will appear that the maximum discharge from the Mustinka watershed was recorded April 1st, 1917, as 2,240 second feet, or, in round figures, three second feet per mile of area. The period covered by the latter record is that of 1917-1919, that is, *subsequent to the flood years here in question*. The importance of this table for its bearing on the issues of the present case is disclosed in the circumstance that taking all of the rivers in the area which outlet at or south of

Fargo (the area comprising that with which we are dealing), the maximum recorded discharge is less than one cubic foot per square mile with the single exception of the Red River which, on July 11th, 1916, showed approximately 1.10 cubic feet.

The records on these rivers have been kept for upwards of 15 years and the resulting maxim may therefore be taken as fairly typical.

In this connection it should not be overlooked that the discharge record of the Mustinka watershed covers the period *subsequent to the installation of the artificial ditching.*

It thus appears that the run-off from the Mustinka under the artificial conditions was *more than double* that of any of the other streams in the immediate region where such artificial conditions were lacking.

The matters thus indicated are further confirmatory of Professor Chandler's statement to the effect that under natural conditions the maxim discharge from the Mustinka watershed would not have exceeded two cubic feet per square mile of area. That he did not mean by this that he would expect a discharge of this magnitude under natural conditions but that in no event would it have exceeded that amount (Original Record, pp. 550, 852, 853).

The remaining rivers disclosed by the table in the northern portion of the area show wide variation in their maximum as well as greater discharge. Thus the Minnesota Wild Rice River shows approximately 11 second feet per square mile of watershed area. The date however discloses this was the result of the unprecedented storm, which centered over that area and the effects of which have been previously referred to in this argument. The Thief River

shows approximately four second feet on April 23rd, 1916. This phenomena however is explained in Table 9, p. 32, disclosing one of the great storms in its area during the four previous days in which was concentrated a precipitation of practically three inches.

Without pursuing the details further it will suffice to state that by comparing the maximum discharge dates of the remaining rivers with the table of concentrated storms last referred to, it will appear that in each instance the recorded maximum followed the storm, thus depriving the apparent deductions from such discharge records, of force.

The showing of the small streams is of no consequence for the obvious reason that their manifestations are largely temporary and widely variant. Furthermore, the limited watershed reflects itself in greater run-off per unit of watershed area.

See Bulletin, p. 39.

Comparisons of stream flow and discharge between the rivers of the northern and southern sections of the entire watershed involved, are of doubtful value without knowledge of topography and other strictly local conditions naturally reflecting themselves in run-off, including artificial drainage.

The significance of the feature of artificial drainage is disclosed by reference to Table 14, p. 57 of the Bulletin, from which it appears that of the total low land area in Minnesota comprised within the watershed of the Red River of the North (4,391 square miles) 1,814 square miles or 41.3% are within a half mile of such drainage.

The only other matter in the bulletin requiring review is that disclosed in Table 5, p. 22, disclosing the *estimated*

future maximum discharges for the various streams of the watershed for both spring freshets and summer floods.

What was said above with respect to the table of maximum *actual* discharge is equally pertinent to the table under consideration.

It must be borne in mind however, that in making such estimates, the authors' objective is the project of general flood relief proposed by them. Hence, the element of speculation and safeguarding future contingencies necessarily characterize these computations. Such estimates necessarily take cognizance of the effects of local storm conditions which have manifested themselves in the past in the different watershed areas upon the hypothesis that repetitions of similar phenomena were likely to recur. Furthermore the maximum actual readings reflect themselves in correspondingly increased estimates of future discharge.

It will be recalled that as applied to the particular watershed in question, no records exist of abnormal storms which have reflected themselves in the volume of run-off. Any deductions attempted to be drawn from the comparison of these various estimates will necessarily be wholly misleading without knowledge of the local conditions, including both those of natural and artificial origin.

This latter view is sufficiently reflected by the authors themselves in the following statement:

> "In the present instance, however, each watershed is a problem of itself and any attempt to calculate run-off for the larger watersheds (say those of more than 200 square miles) by formulae is likely to give results which would be quite unreliable owing to the wide variation of the influencing conditions and to the difficulty of assigning definite values to them" (p. 48).

For what it is worth however, we have the confirmatory

estimate in this table of slightly over 3,000 second feet discharge from the Mustinka watershed (as against Professor Chandler's computations of actual discharge in 1916 of 3,500 second feet), disclosing the minor difference of a fraction of a foot per square mile of watershed area.

We have already shown that this is double the run-off which could have existed under natural conditions. The result is conclusive of the effect of the artificial ditching.

CONCLUSION.

In conclusion, at the expense of some repetition, it is desired to direct attention to certain of the more general aspects of the case and particularly to the policy and methods that have been observed on the part of the defense.

In the inception it will be recalled that Minnesota, by its answer, substantially admitted the principal charges in complainant's bill. There was no denial that the agencies of that state were contributing causes to the trespass and damage charged by complainant. The gist of the defense (if it may be so termed) consisted in the claim it was impossible to ascertain the precise extent to which those agencies had contributed to the perpetration of the wrong.

There was thus no pretense in the allegations of the answer that the physical conditions within the Mustinka watershed were essentially different than as charged by the bill. Similarly, there was no pretense that the artificial agencies constructed in that area to alleviate those conditions had not been effectual in the accomplishment of the purpose for which they were intended.

Taking the answer in its entirety therefore, it was clear that the defense was not intended to be rested on a denial

of the facts but rather on a justification predicated of the circumstances the agencies complained of had been created in connection with a great system of internal improvement and reclamation of valuable agricultural lands, within the limits of Minnesota, whose utility had been impaired by lack of necessary natural drainage. Concisely, this justification was predicated of the claim that a far greater and more valuable area had been benefited in Minnesota than had been damaged in North Dakota as a result of casting the former's burdens on the latter's domain (Original Answer, Record, p. 27).

Such, in substance, were the issues as originally tendered by the pleadings filed in this court.

In this connection it should be noted that the essential details of the conditions thus substantially admitted by the answer were confirmed and attested by the findings of the legislature of Minnesota as specifically enumerated in the recitals of the Preamble of its Act already sufficiently reviewed in complainant's original brief.

What was attempted to be established in the proofs originally offered on Minnesota's behalf, presents a marked contrast to the matters thus alluded to. It is both interesting and instructive to follow the devious course and method by which the substantive issues were sought to be evaded in the evidence.

The record as originally submitted to this court was extended beyond all justification and reason with largely frivolous, immaterial and cumulative detail for which no other reason may be assigned than a studied and deliberate purpose to becloud the issues and divert attention from the comparatively narrow scope of the actual controversy presented for the court's determination.

To such an extent were these methods carried that it became apparent to complainant the objective purpose was to make a record of such magnitude, complainant would abandon the prosecution of the case in preference to meeting the excessive costs and expense incident to its conduct. Application was accordingly made to the court to compel Minnesota to defray a portion of this expense. The details of the methods mentioned were so fully set out in that application as to render repetition in this connection unnecessary.

The important feature from the present standpoint is disclosed in what appears fairly obvious, viz.: that these methods have proceeded from a studied policy of evasion which has characterized Minnesota's attitude throughout.

The evidence originally offered in Minnesota's behalf was directed at establishing there was no area in that state requiring drainage; no lands therein subjected to periodic overflow whose reclamation required the vast artificial ditching system constructed by the various local subdivisions of that state, all of which functioned and was made effective by the main ditch constructed by state agencies and paid for by state appropriation; that the existing physical conditions disclosed no reason for the installation of this great drainage system, and finally, if the facts should be determined otherwise than as last stated, that the drainage system so constructed had failed to function and had served no purpose so far as drainage was concerned.

Literally hundreds of pages of testimony were taken and incorporated in the record returned to this court to which no other substantive purpose can be assigned than the exposition of the purely imaginative and fictitious features

thus alluded to.

Forced to extremes by the methods thus indicated, counsel for Minnesota sought to stultify the legislature of that state by openly charging the findings of that body, as recorded in its formal enactment, were false in all essential particulars.

It is not proposed to re-review the vagaries and inconsistencies of the evidence thus mentioned. This feature has already been sufficiently covered in the original brief filed in complainant's behalf.

The matters thus alluded to are important in emphasizing the policy which has been observed by Minnesota throughout the proceedings as originally had in the cause and as presaging the continuance of the same policy in the later proceedings, the record of which is now submitted.

Thus it will be noted that in the supplementary proofs offered in response to the court's order, Minnesota has not addressed the proofs offered in her behalf to any matters of issuable character in the case. Attention is again sought to be diverted from the legitimate issuable facts by stressing and emphasizing matters with which the case has no concern and over which, for reasons already sufficiently disclosed, neither this nor any other court has jurisdiction.

Attention is thus sought to be concentrated on general flood conditions in the region in question and the expediency, as well as practicability, of ameliorating those conditions by joint state co-operation. If the futile attempt to open issues formerly tried and finally submitted to the court be excluded, the entire evidence now offered in Minnesota's behalf is, we think, fully and fairly summarized in the above statement.

It is difficult to characterize methods such as those al-

luded to any more clearly than they obviously characterize themselves. If these comments manifest impatience, the justification from the standpoint of complainant's counsel must be found in the conditions with which the latter have been confronted throughout this case in their attempt to make a clean-cut and concise presentation of the pertinent facts as well as the determinative legal questions.

Reduced to their lowest terms, the facts in this case have been established by so overwhelming a preponderance of evidence in complainant's favor as to remove this feature from the realm of serious controversy. There remains then only to apply well settled principles of law to the facts thus established.

That Minnesota has committed a trespass on the domain of complainant state and that such trespass carries with it the ordinary and usual responsibilities is thus necessarily assumed. Appropriate relief by way of injunction with reparation for the damages caused by the invasion follow practically as a matter of course in the ordinary case where private rights are concerned. No reason has been suggested or authority cited to the effect that similar relief, at least, should not be granted where the rights infringed are those of a state and the wrong is perpetrated by another state.

As a matter submitted to and clearly within the jurisdiction of this court, it is further necessarily assumed that every issue and question presented on the record and necessarily involved in the determination of the rights and obligations of the respective parties, may and will be comprehended within the terms of the final decree to be rendered. *Semble* that there can be in such case no ap-

portionment or division of jurisdiction in such manner that any part of the controversy may be transferred or delegated for the disposition of any other agency or tribunal.

All efforts to inject features or theories suggesting that the court may or should withhold its hand or that it should substitute the action or decision of any other tribunal in the final disposition of any feature of the case must prove futile. As a judicial controversy the cause itself must be judicially determined. Otherwise, it loses its distinctive justiciable character.

When North Dakota exercised its constitutional privilege of invoking the jurisdiction of this court, it irrevocably submitted itself and the determination of its rights to that jurisdiction. It did not in so doing consent to the consideration of subjects wholly extraneous to those with reference to which the jurisdiction of the court was invoked or to submit wholly foreign matters to the court's determination.

Assuming therefore North Dakota has established the single claim asserted by its bill in this cause (without the establishment of which no judicial controversy is presented) it contends it is entitled to all of the usual and appropriate relief as prayed in such bill. In so far as that relief consists in the right to an injunction, North Dakota has frankly conceded in the foregoing argument that if Minnesota can accord *equivalent relief* other than by means of such injunction, it may equitably be accorded the privilege, *provided,* the alternative shall (1) be an actual *equivalent* and as such, calculated to afford substantially the same measure of redress and protection as would be afforded by the injunction itself, (2) that the requirements of such alternative shall be fixed with reasonable

certainty by the terms of the decree in such manner as to preclude evasions, (3) that the decree shall fix a reasonable time within which such alternative (if accepted by Minnesota) shall be exercised and the improvements thereby contemplated completed, and finally (4) that on failure to accept such alternative or after acceptance, to carry out the requirements thereof, that complainant be held entitled to the injunctive relief as prayed.

In so far as the relief prayed for by the bill includes reparation by way of damages for injuries to the domain of North Dakota it is contended that nothing in the supplementary proofs now submitted, in any wise changes the status of the case as originally presented to the court. That whatever disposition may be made with respect to the injunctive feature of the case, North Dakota is entitled to recover the damages sustained for the three successive years, during which the large area disclosed in the original proofs was practically destroyed for all purposes of husbandry, with the incidental loss and damage as disclosed by those proofs.

North Dakota accordingly submits that on the proofs as now adduced it has fully justified the charges on which the instant case was based and established its right to the relief as prayed in its bill, modified only in the respects above noted.

Respectfully submitted,

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Supreme Court of the United States.

OCTOBER TERM, 1919.

No. 10 ORIGINAL.

THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA.

BRIEF AND ARGUMENT ON BEHALF OF THE STATE OF NORTH DAKOTA, COMPLAINANT.

THE STATE OF NORTH DAKOTA,
Complainant.
By WILLIAM LANGER,
Attorney General.

M. H. BOUTELLE,
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Of Counsel for Complainant.

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Supreme Court of the United States.

OCTOBER TERM, 1919.

No 17 ORIGINAL.

THE STATE OF NORTH DAKOTA,

Complainant,

vs.

THE STATE OF MINNESOTA.

BRIEF AND ARGUMENT ON BEHALF OF THE STATE OF NORTH DAKOTA, COMPLAINANT.

This proceeding was initiated on a Bill exhibited in a suit of equitable nature, invoking the original jurisdiction of this Court, by the State of North Dakota as Complainant, against the State of Minnesota.

On application seasonably made, leave to file was granted by the Court. Thereafter, process duly issued and was served on the State of Minnesota, which entered its appearance and filed its answer. By subsequent order, the case was referred to a Commisioner to take the evidence and report the same to the Court.

The evidence, having been returned by the Commissioner, was filed by leave of the Court and the record printed in accordance with the rules. Thereupon, on motion of the complainant, the cause was assigned for final hearing on the pleadings and proofs.

HISTORY OF THE CASE.

It may serve to clarify the matters to be later discussed if a brief history of the nature and circumstances of the controversy be given at the outset.

North Dakota and Minnesota are contiguous states, the former bordering the latter on the West. The dividing line at the point here in controversy, is the middle of the channel of the Bois de Sioux River, the latter a tributary of the Red River of the North. The Bois de Sioux River has its source in Lake Traverse, located just South of the southerly boundary of North Dakota, of which lake it is the outlet. The flow of the waters at this point is toward the North.

Lake Traverse constitutes a natural basin or reservoir for the drainage of relatively large areas within the states of Minnesota and South Dakota. The overflow of this natural basin is the Bois de Sioux River, the channel capacity of which is relatively limited, having a width at the point in controversy varying from one to four rods and a depth of three or four feet.

The lands in North Dakota and Minnesota, on either side of the Bois de Sioux are of level, prairie formation, sloping slightly on either side toward the river, and toward the North, with the exception of an area within the State of Minnesota, comprising what is known as the Mustinka watershed, of approximately 750 square miles.

As the questions in the case deal largely with the drainage by Minnesota of this watershed, its topography will call for later detailed consideration. For the purposes of this preliminary statement however, it will suffice to allude to certain general features with reference to which there is no material dispute.

Its easterly portion, embracing slightly less than one-

half the total area of the water-shed, comprises a hilly, broken region with much higher mesne elevation than the adjoining prairie formation to the West. For convenience this easterly area has been termed the moraine zone. The drainage of the northern part of this zone is toward the South and of the southern part, toward the North, the point of confluence being at its westerly margin, practically equi-distant between the northern and southern sections, when it follows the channel of the Mustinka River which extends approximately 15 miles in a general westerly direction through the prairie formation, and is then deflected southwesterly to its outlet in Lake Traverse.

The westerly portion of the watershed, comprising slightly more than half of its entire area, has an irregular circular outline. The land is of level, prairie formation with a general slope to the north and west. The main drainage channels of this portion are what are known as Five Mile and Twelve Mile Creeks which outlet in the Mustinka River near the northerly margin of the area and thence follow the latter's main channel west and thence southwest into Lake Traverse. It will thus be seen that the topography of this portion of the area is such that the natural drainage channels descry a complete loop flowing northerly from point of origin, thence westerly and thence southwesterly to their ultimate discharge outlet.

For all practical purposes of this case, the Mustinka River furnishes the single drainage outlet for the entire area of the watershed.

In its natural state, the Mustinka River had negligible channel carrying capacity through this prairie formation. Its course was winding and irregular with low banks and relatively shallow channel depression. As a result, in

times of spring break-ups and other periods of excessive precipiptation, the waters tended to accumulate and overflow at the confluence, following a series of irregular flood channels toward the west.

The general area of confluence and overflow comprises some 75 square miles. This area for convenience is termed the delta zone.

The topographical features of this zone present what is termed by engineers a natural detaining basin for the accumulated surface waters. The inadequacy of the discharging channel retarded its drainage and a comparatively large portion of the acumulated waters was lost through evaporation, seepage, etc., thus never reaching the ultimate outlet in Lake Traverse.

With a view to remedying these conditions and providing adequate drainage for the delta zone, the entire area was gridironed by a system of what are known as local or county ditches, the whole system functioning thru a main canal or ditch (the Mustinka State Ditch) constructed by the State of Minnesota under the supervision of its State Drainage Commission with appropriations for that purpose from its State Treasury.

The first portion of this state construction known as the original Mustinka ditch, was constructed from the easterly margin of the delta zone practically on a due east and west line for a distance of approximately seven miles. This ditch substituted for the tortuous and practically indistinguishable channel of the Mustinka River, a clear, well defined channel of incalcuably greater carrying capacity. The result of its construction was the transfer of the accumulated surface waters from the easterly to the westerly area of the delta zone and their still greater accumulation at the latter point. Lacking adequate outlet, the only effect of the original ditch was to

transfer the burden of the floods further to the west with the consequent inundation of a different area.

In response to petitions and complaints of land owners damaged by the conditions last described and after investigation through its duly constituted committees, the legislature of Minnesota, finding the conditions as indicated, provided for the extension of the original ditch and appropriated funds therefor. This resulted in constructing what is known as the extension, running practically due east and west from the outlet of the original ditch to a point where it intersected the channel of the Mustinka River in the latter's course to the south.

This portion of the extension is termed the cut-off by reason of the fact that it cuts off a long, tortuous detour of the river to the north, correspondingly lessening the distance to the outlet.

From the point of confluence of the cut-off with the main river channel, the latter was dredged and straightened throughout its entire distance to its outlet in Lake Traverse. This is what is termed the rectified channel. The depth of the cut at various points was from three to fifteen feet deeper than the natural channel and the distance shortened approximately three miles. The extension was completed to within a few miles of the outlet in Lake Traverse in 1914, and the intervening area dredged in 1915.

The substitution of this system of artificial drainage for that naturally existing destroyed the effect of the delta zone as a natural detaining basin. In consequence, the flow of the waters of the watershed was accelerated and the volume discharged in Lake Traverse practically doubled. This resulted in surcharging the lake,

causing its overflow and the inundation of the whole Bois de Sioux Valley.

Under natural conditions, the lands in the Bois de Sioux Valley had been subject to periodic and temporary overflows. These however, had never previously occurred except in spring break-ups following winters of excessive precipitation. The maximum periods of these overflows had been from a week to ten days, and their occurrence had not prevented the use of the lands for the ordinary agricultural purposes for which they were adapted. Previously to the construction of the artificial drainage system in Minnesota, no overflow of these lands had ever been known during the summer season and no previous inundation at any season compared in its duration with that occurring in 1915 and 1916.

In the fall of 1914, following the relatively heavy precipitation of the summer of that year, the valley lands were flooded to a limited extent. The flood waters however receded during that fall and Lake Traverse reached its normal level.

The winter of 1914-'15 was one of practically normal precipitation and no flood conditions were manifested in the spring break-up. During the early summer of 1915 when the valley lands were covered with standing crops and after the grain was headed out, the waters in the valley commenced to rise. The flood increased until its crest was reached the latter part of July of that year. Approximately 10,000 acres in complainant state were overflowed. The crops were totally destroyed. The inundation continued throughout the summer and fall, during which there was some recession of the waters. For the most part the lands remained inundated and froze up in that condition.

In the spring of 1916, the lands were again flooded.

The area inundated exceeded that of the previous year. The greater portion remained inundated throughout the summer until late in the fall when the waters gradually receded. Their recession left the lands covered with a deposit of mud and silt and overgrown with rushes and aquatic grasses.

All of the flooded lands were occupied and used for farming purposes. They were cropped in 1915 before the flood started and the standing grain was submerged and destroyed. They were *a total loss* from the standpoint of husbandry during the years 1915 and 1916 and most thereof, wholly unfitted for such uses in 1917.

The feature of damage directly to the complainant state itself, as well as that sustained by its citizens may, however, be postponed for future consideration; likewise, the incidental feature addressed to the considerations of public health from submerging large areas with stagnant waters, thus constituting a nuisance.

The gravamen of the charge presented on these facts is, in substance, that the condition of flooding with the resultant damage, was due to the artificial drainage system constructed by Minnesota. That the results constituted the commission of a trespass by Minnesota on the domain of North Dakota. That the conditions have already been productive of irreparable damage to the complainant state and if continued, will result in a continuing trespass and invasion of its domain with consequent loss of a character not susceptible of adequate reparation by any pecuniary recovery.

These conditions have resulted from the fact that Minnesota, for the purpose of draining and improving large areas within that state, has constructed a system of state ditches or canals which have accelerated and increased the discharge of the surface waters, naturally ac-

cumulating within its limits, into the natural watercourse, constituting the boundary line between it and complainant, in a volume greatly in excess of that which would have been naturally discharged and of the capacity of that water course.

To all practical intents and purposes, Minnesota has sought to relieve its own area by transferring the burden of the waters there naturally accumulating, on to the domain of the complainant state.

The physical conditions disclose that if the artificial system of ditches and canals thus constructed by Minnesota is continued to be maintained, periodic recurrences of the trespass on the domain of North Dakota with the consequent loss and destruction of property are inevitable.

The object of this proceeding is, to restrain the commission of such trespass and obtain reparation for the damages sustained.

The substantive facts thus referred to are amply sustained by the proofs as will be demostrated by their review in the succeeding argument.

Preliminary Survey of the Questions of Law.

Assuming the complainant has established the matters thus far reviewed, the question immediately arises as to the appropriate method for obtaining relief. Concretely stated, the question is, what is the nature of the remedy available by one state for a trespass committed on its domain by another state.

The decisions of this Court remove any doubt as to the answer.

See *Georgia v. Tennessee Copper Company*, 206 U. S. 230;

Kansas v. Colorado, 185 U. S. 125.
Missouri v. Illinois, 180 U. S. 208.

In *Georgia v. Tennessee Copper Company, supra*, the determinative principles were thus stated:

> "This is a suit by a state for an injury to it in its capacity of *quasi-sovereign*. In that capacity the state has an interest independent of and behind the titles of its citizens, *in all the earth and air within its domain*. * * * When the States by their union made the forcible abatement of outside nuisances impossible to each, they did not thereby agree to submit to whatever might be done. They did not renounce the possibility of making reasonable demands on the ground of their still remaining *quasi-sovereign* interests; *and the alternative to force is a suit in this court.*" (Italics ours).

Notwithstanding the principles thus settled, it is alleged by Minnesota in its answer as follows:

> "That the complainant herein has no interest as a state in the relief or any part of the relief demanded by the bill herein, in this, that all of the damages done or likely to be done, if any have been done or may hereafter be done, of the nature of those alleged in the bill have been done or will be done to the residents of the state, and the complainant is not the real party in interest, but only individual citizens and municipalities of that state and persons resident therein and these wholly as to their individual property, and the defendant therefore pleads in bar to this action and all of it, that such general governmental interest of the state of North Dakota in its citizens is not such that complainant may bring against the State of Minnesota an action to recover damages for injury to, or to prevent such future injuries of like kind to, the property of its individual citizens." (Sub-division 11, p. 2, Answer of the State of Minnesota.)

Wholly apart from the feature of financial loss directly sustained by the complainant and even if the facts were

as assumed in the excerpt from the answer just quoted, it is inconceivable that the forcible trespass on the domain of a state presents a question in which it has no standing or interest.

In matters such as those with which we are dealing, the rights of a state are co-extensive with its territorial domain. Where any part of that domain is threatened with, or invaded by, force, questions of the immediate private interests affected are wholly subordinated to the broader and underlying principles of the sovereign's proprietary rights. This was clearly indicated in the language of this court already quoted from *Georgia v. Tennessee Copper Company, supra,* as follows:

> "In that (its *quasi-sovereign*) capacity, the state has an interest independent of and behind the titles of its citizens in all the earth and air within its domain."

While under our system it is probably inaccurate to refer to the States as sovereign, in the sense in which that term is understood according to the usages of International Law, it nevertheless remains that the solution of many questions, arising between them, must be found by application of principles analogous to those applied in dealing with independent sovereignties.

The constitutional inhibition forbidding a suit against a state, by a citizen of another state, reflects a well established rule of International Law, under which the redress of grievances of the nationals of one sovereign, against another and independent sovereignty, is of public and national, as contradistinguished from private concern.

The remedy in this court, under the constitution, furnishes the substitute for redress through diplomacy under the prevailing rules of International Law.

This was clearly indicated in the decision of this court in *Missouri v. Illinois,* (180 U. S. 208) *supra,* in the following language:

> "An inspection of the bill discloses that the nature of the injury complained of is such that an adequate remedy can only be found in this court at the suit of the State of Missouri. It is true that no question of boundary is involved, nor of direct property rights belonging to the complainant state. • • • If Missouri were an independent and sovereign state all must admit that she could seek a remedy by negotiation, and, that failing, by force. Diplomatic powers and the right to make war having been surrendered to the general government, it was to be expected that upon the latter would be devolved the duty of providing a remedy and that remedy, we think, is found in the constitutional provisions we are considering."

The general principle was stated in *Debs, Petitioner,* 158 U. S. 564 as follows:

> "That while it is not the province of the government to interfere in any mere matter of private controversy between individuals, or to use its great power to enforce the rights of one against another, yet, whenever the wrongs complained of are such as affect the public at large, and are in respect of matters which by the constitution are entrusted to the care of the Nation, and concerning which the Nation owes the duty to all the citizens of securing to them their common rights, then the mere fact that the government has no pecuniary interest in the controversy is not sufficient to exclude it from the courts, or prevent it from taking measures therein to fully discharge those constitutional duties."

In *Kansas v. Colorado,* 185 U. S. 125, 142, upon review of the holding in *Missouri v. Illinois, supra,* this court states:

> "As will be perceived, the court there rules that the mere fact that a state had no pecuniary interest

> in the comtroversy, would not defeat the original jurisdiction of this court, which might be invoked by the state as *parens patriae,* trustee, guardian or representative of all or a considerable portion of its citizens."

The application of the principles thus announced, removes all doubt of the propriety of the complainant's invoking the original jurisdiction of this court to restrain an unlawful trespass on its territorial domain. The citizen is remediless under such conditions and unless redress for the wrongs which he has suffered may be invoked at the hands of the state, it necessarily follows that the wrong itself, however flagrant or egregious, must go unredressed.

For the purposes of this preliminary statement of legal principles, it is unnecessary to determine whether the respective rights and obligations are to be determined upon application of settled principles of International Law or those of the common law, for the reason that our immediate present concern addresses itself exclusively to the right of a sovereign or *quasi- sovereign* to appropriate relief against the forcible trespass on its domain by another state, or the latter's agencies.

We are similarly not concerned for the immediate present with the precise nature of the remedies appropriate to redress such grievances and may therefore content ourselves with the statement that, as in all other cases, equity will adapt its relief to the circumstances of the particular case, in such manner as to fully protect against the future repetition of the wrong, with reparation for the injury already inflicted.

The only other general feature, which may be profitably alluded to at this point, arises from the claim in the answer of the State of Minnesota, that the matters here com-

plained of arise and grow out of improvements of its own public domain, undertaken in the interest of the welfare of its citizens and carried out in accordance with the authority invested in its administrative officials by its local law.

It should be obvious, without the requirement of detailed argument, that assuming the conditions to be as thus claimed, the rights and privileges invoked are not without legal limitations and certain reciprocal obligations recognized, to some extent, between nations and individuals alike, that such privileges may not be exercised and such local benefits sought, where the natural and necessary result of their accomplishment involves unlawful interference with the rights of others. In other words and expressed in more practical language, while it may be assumed Minnesota is within her legal rights in undertaking the improvement of her public domain, it does not follow that such results may be lawfully accomplished by transferring the burden to a neighboring state.

The right of drainage for the reclamation and improvement of the public domain may be broadly conceded as may also be the right to employ the natural water courses for that purpose. This right however, is attended with well established reciprocal obligations under which the employment of boundary waters and channels must be such as to not impose excessive and unnatural burdens thereon with the resultant flowage and inundation of the riparian properties of neighboring commonwealths.

Analysis of the Pleadings.

An analysis of the pleadings will disclose that the issues between the parties, as thereby presented, are reduced to relatively narrow limits.

Apart from formal jurisdictional allegations, the complaint alleges the matters hereinabove referred to with somewhat more particularity of detail.

The answer substantially admits the various topographical features as alleged in the bill. The differences relate to matters of minor detail which have ceased to be of any importance in the case.

The flooding of the lands in the Bois de Sioux Valley in the years 1915 and 1916 is admitted with the qualification that these lands had been similarly flooded in previous years before the construction of the artificial drainage system in Minnesota. (Rec., 20, Answer, Par. IV).

Contribution to the floods complained of by the Wild Rice River in North Dakota (Rec. 21, Answer, Par. V); the Otter Tail River in Minnesota, (Rec. 21, Answer Par. XVIII) and ditching construction in the States of North and South Dakota. (Rec., 27, Answer, Par. XVIII) is alleged but no claim is made for these features in the evidence.

Contribution to the floods is similarly alleged to have occurred from the action of the waters of the Rabbit River (Rec. 26, Answer, Par. XVI) but the proofs disclose this contention is one of largely moot significance.

The substance of the issue tendered is found in Par. XVIII of the answer (Rec. 26) which denies that the ditching construction in Minnesota was the responsible cause of the floods complained of and alleges that such construction was only one of a series of contributory causes to those floods, the respective contributions of which could not be definitely assigned or determined.

Apart from the issue of damage, this presents, to all practical intents and purposes, the single substantive issue between the parties as tendered by the pleadings.

Incidentally, it is alleged in the answer that the drainage in Minnesota has been necessary for the improvement of large areas within its limits and the better adaption of those areas to agricultural purposes. Also, that the artificial drainage has followed and employed the natural discharge channels, etc., (Rec. id.)

For their bearing on the questions raised by the evidence and to be presently discussed, specific allusion may be made at this point to certain admissions of the answer. For purposes of accuracy, these last are quoted verbatim:

> "That in conformity to the provisions of the act of the legislature set forth in full in paragraph sixteenth of said bill of complaint, and by aid of a supplemental appropriation therefor made in 1915 and for the purpose of improving the public health of the people living in the low land drained and about to be drained by the construction of a ditch along the general line and direction of the Mustinka River, such ditch was built. * * * The defendant admits that as a result of said construction so far as the same followed the general course of the said Mustinka River, the latter was for the most part, but not wholly nor in all places straightened or widened or deepened, and admits that the new and artificial channel superceded the previously existing natural channel."
>
> Answer, Par. XV, Rec., 25.
>
> "That the benefits from the construction of said ditches in the State of Minnesota were many times greater than the damage and loss caused by the overflow of the said Lake Traverse and Bois de Sioux River; that as a result of such drainage hundreds of farms have been benefitted and thousands of acres rendered dry and tillable, beneath the surface of which land the water table was, during the growing season before such ditching, only a few inches, or at most a foot or two."
>
> Answer, Par. XVIII, Rec. 27 (57.)

"That there is between this marsh (Tintah Slough) and surrounding country a slight ridge shown upon complainant's Exhibit "A" by a dotted line shaded yellow through the north tier of sections of township one hundred twenty-eight (128), range forty-five (45); that south of said ridge is a low area approximately like that described by complainant in the seventh paragraph of its bill and which area alone is properly called in connection with the Mustinka River basin the "delta zone"; that said delta zone is not level but slopes northwesterly at an average rate of about five (5) feet to the mile as is shown by the comtour lines on complainant's Exhibit "A", which slope was sufficient to cause a reasonable drainage of the surface in ordinary seasons."

Answer, Par. VII, Rec. 22 (48.)

"That the overflow of the Mustinka delta zone above described was not sufficient to permanently inundate or saturate the soil, but only to do so in the spring after snowfall was heavy or at other seasons after unusual rainfall and then only for a relatively short time after the spring freshet was over or the unusual rainfall had ceased."

Answer, Par. VIII, Rec. 22, (48.)

"That under normal and natural conditions the entire flow of the Mustinka delta area was through the Mustinka River into Lake Traverse, which lake naturally, and particularly in times of high water, constituted an impounding and distributing reservoir and thereby the waters of the Mustinka River were retained and gradually allowed to discharge therefrom through the Bois de Sioux River and thus to protect the people along the valley of the Bois de Sioux River from injury from overflows."

Answer, Par. XI, Rec. 23-24.

"That the area prior to the construction of the second Mustinka State Ditch, in which waters were accumulated, was less than sixty (60) square miles and said sixty (60) square miles were overflowed only at times of excessive high water."

Answer, Par. XIII, Rec. 24.

"That the waters so cast into said lake and river were accelerated by the ditching projects of the State

of Minnesota, and its subdivisions and contributed to the water which inundated the lands described in the bill; that said water was collected and cast with greater rapidity and volume into the said lake and river as a result of the necessary drainage of low areas located in the State of Minnesota, etc."

Answer, Par. XVIII. Rec. 27 (56.)

In the foregoing analysis of the pleadings, no refer- has been made to the allegations of either the bill or answer with respect to the feature of damage resulting from the floods which is reserved for consideration at a later point in this brief.

For all purposes of the issues thus tendered and particularly in the light of the admissions of the answer above quoted, it may, we think, be assumed that no question is presented with respect to the artificial drainage of the delta zone or the necessity of such drainage to relieve the accumulation of waters therein. Also, that this area was in fact drained by the construction of the ditching system into Lake Traverse. Also, that the result of such drainage was that the accumulated flood waters from the delta zone were discharged in greater volume and in less time into Lake Traverse than would have occurred under natural conditions.

Hence, that so far as the issues tendered by the pleadings are concerned, the single question presented by the evidence is that already stated, viz: whether the artificial ditching construction in Minnesota, with the consequences naturally resulting therefrom, was the responsible cause of the floods here complained of.

Outline of the Evidence of the Respective Parties

I.

The Contentions of the Complainant.

1. With respect to the natural topographical conditions, the evidence of the complainant established the allegations of the bill already sufficiently explained.

See generally testimony George A. Ralph, Rec. 303.

2. The testimony of residents of the flooded area in complainant's state disclosed:

(a) That the area in question had been settled for upwards of thirty (30) years, during all of which time the greater part of the lands had been cultivated and improved for the ordinary purposes of agriculture and that said lands were amongst the most fertile and valuable of any within the state;

(b) That in times of excessive high waters in spring break-ups, these lands were subject to temporary overflow, but that such periods of overflow had been of short duration varying from three to ten days and had never (previously to the times in question) prevented their use for general agricultural purposes; that is, raising the ordinary cereal crops grown in that region.

(c) That there were no exceptional or unusual weather conditions in the years 1914, 1915 and 1916. That the conditions during those years were substantially the same as those existing at various periods in the preceding years;

(d) That no such flood conditions as those existing in the years 1915 and 1916 had previously been known in the Bois de Sioux Valley;

(e) That in the spring of 1915 there were no conditions of flood; that the lands bordering the river were cropped as usual and that the grains were headed out in the month of May;

(f) That during that month the waters commenced to rise and continued until substantially the entire area as shown on complainant's Exhibit "A," was inundated; that the crest of the flood was reached the latter part of July; that the greater part of the lands remained inundated throughout the remainder of the season; that the waters receded slightly during the fall but froze up over the larger portion of the inundated area in the winter of that year.

(g) With the opening of the spring of 1916, the waters in the valley rose again, the flood crest being reached in April of that year, at which time the water levels were higher than during the preceding year and a correspondingly greater area inundated;

(h) That the flood waters during both seasons came from Lake Traverse at the south and were flowing north in the main channel of the Bois de Sioux with a sluggish current. That there was little or no perceptible current in the inundated area where the water remained, practically stagnant, during both years.

(i) That there was a gradual recession of the flood waters during the summer and fall of 1916 but that the waters had not subsided and uncovered the overflowed area until late in the fall of that year, when the lands were left covered with a deposit of mud or silt which, in addition to their wet and saturated condition, rendered their use impossible;

(j) That the opening of winter in 1916 found the

lands in the condition last above indicated in which they froze up;

(k) That the winter of 1916-1917 was one of low precipitation. That of the entire season of 1917 was one of extreme drouth.

(l) There were no floods in the spring of 1917 but the opening of that season found the inundated area thoroughly saturated; covered with the deposit of mud or silt and in many places grown up with rushes and aquatic grasses thus rendering it impossible to employ or use other than a nominal portion thereof for any purpose of agriculture during that year.

See generally the testimony of Peter G. Smith, Rec. 46, (90), 47, (91), 48 (93), 50 (95), 51 (96-97), 52 (98), 53 (100), 54 (101.)

Charles R. Pinkey, Rec. 67 (119), 68 (120), 69 (122), 70 (123), 71 (124), 72 (126), 73 (127), 74 (128-129), 75 (130), 78 (134-135), 80 (136-137), 81 (13

See also testimony *Burke Kurtz,* Rec. 114 *et seq.*

Theodore Brackin, Rec. 204 *et seq.*

Wallace G. Taylor, Rec. 249.

B. W. Schouweiler, Rec. 275.

J. H. Bolton, Rec. 284.

These witnesses were property owners who had resided and been engaged in farming operations in the area in question continuously for periods ranging from fifteen to upwards of thirty years. For all practical purposes in determining the questions here presented, the facts attested by them may be regarded as undisputed.

See also E. N. Nelson, Rec. 1696.

3. The scientific or engineering features of the evidence addressed themselves to what may be conveniently classified as follows:

First: That the conditions in the Mustinka watershed in a state of nature were, as in all other regions, controlled by the existing physical conditions as attested by the contours and indubitably disclosed by the natural drainage channels. Incidentally, that is was inevitable the level area embraced in what for convenience may be termed the confluence of the Mustinka River with its tributaries, the Five Mile and Twelve Mile Creeks should constitute a natural flod plain or basin; that the flow of the flood waters therein was limited by the natural conditions including (a) the discharge capacity of the Mustinka River in its natural state; (b) the effects of evaporation, and (c) the elements of soil absorption, transpiration, seepage, etc.

Second: That the conditions thus attested were, in substance, the same as those found by the legislative investigation committee of Minnesota, included in the reports to the legislature of that state and embodied in the preamble of the act of its legislature authorizing the construction of the Mustinka State Ditch.

Third: That the existence of the flood plain with its consequent natural effect as a detaining or storage basin, was still further attested by the necessity of the extensive drainage system gridironing its entire area.

Fourth: That this construction provided a more effective system of drainage of the flood plain or basin by concentrating the flow and permitting the mobilization and transportation of the flood waters to their natural outlets in shorter time and with consequent greater volume than under natural conditions.

Fifth: That the Mustinka State Ditch materially lessened the distance of flow of these waters to their ultimate discharge basin in Lake Traverse, and that the car-

rying and discharge capacity of the ditch was at least double that of the natural channel.

Sixth: That under normal conditions of precipitation these artificial conditions tended to increase the run-off of the watershed and the volume of discharge into Lake Traverse over what would have existed under natural conditions and thus to impair the storage or reservoir capacity of the lake.

Seventh: That these artificial conditions practically doubled the run-off of the Mustinka watershed in flood periods, resulting in an excess discharge over what would have existed under natural conditions, into the Lake Traverse basin and over the natural storage capacity of that basin.

Eighth: That flood conditions generally were predicable of excessive precipitation, concentrated within relatively short periods of time and the usually attendant conditions of spring break-ups. And that these, coupled with the condition of run-off, were the determinable factors in ascertaining the causes of previous floods as well as postulating their future occurrence.

Ninth: That there was nothing in the natural conditions in the region in question in either of the years 1914, 1915 or 1916 which would account for or explain the floods in question. That the natural conditions, with respect to precipitation and otherwise in those years, were not essentially different from those existing in previous years, antedating the construction of the artificial drainage system in Minnesota, when no such floods as those complained of occurred.

Tenth: That the floods in question were caused by the excessive run-off of the waters of the Mustinka watershed, resulting from the artificial construction in Minne-

sota. That under substantially similar conditions there would inevitably be repetitions of such floods as long as this artificial system was continued. That the same or even more favorable precedent conditions must be naturally expected in the future, and that floods of even greater extent and of longer duration in the Bois de Sioux Valley would necessarily follow.

Going, as do the matters thus enumerated, to the crux of the questions involved, the testimony will be reviewed fully at a later point in the present argument.

See generally however, Ralph, Rec. 302 et seq., 304 (448) 308 (455), 309 457, 311 (460), 313 (463), 314 (464), 317 (469), 318 (470), 320 (474), 312 (475), 322 (476.)

Shenehon, Rec. 450 et seq., 453 (690), 457 (696-697), 458 (698), 461 (704), 462 (705-706), 463 (706-707), 464 (708.)

Chandler, Rec. 512 (789), et seq., 513 (791), 515 (794), 516 (795), 517 (797), 518 (800), 519 (800), 519 (801), 520 (802.)

The testimony thus referred to was elicited from engineers of wide experience in the general fields of drainage and flood control, after extended examination and study of the various conditions of the area in question.

Mr. Ralph was State Drainage Engineer of Minnesota having charge of the engineering of the drainage of that state covering the period from 1900 to 1913. Mr. Shenehon was former Dean of the Engineering Faculty of the University of Minnesota. He is an engineer of national reputation who has specialized for many years in hydraulics and been identified with important undertakings dealing with drainage, flood control, etc. Professor Chandler is the present head of the Engineering Faculty of the University of North Dakota. He has had similarly wide

experience in questions dealing with flood control and is probably more conversant with the technical and scientific details covering the subjects of run-off and floods in the general section of the country here in question than any other witness who could have been called. For many years Professor Chandler has had charge for the United States Geological Survey of the river record work covering the States of North and South Dakota and the northwest portion of Minnesota which includes obtaining and classifying the daily, monthly and annual records of flow, as well as similar statistical data with reference to drainage and run-off of this region.

4. The remaining evidence offered on behalf of the complainant was directed at disclosing the damages resulting from the floods. As this will be made the subject of separate consideration later in this brief, further detailed reference at this point is unnecessary.

II.

The Contentions of Minnesota.

From the mass of detail with which the record in this case has been burdened, it is difficult to segregate and classify in concrete form, the contentions relied on by way of defense. The following summary however, may indicate what we assume are intended as the more essential features.

1. Ignoring the issues made by the pleadings and the admissions of its own answer with reference to the physical character of, and conditions existing in, the delta zone, much fruitless effort was expended in the attempt to establish there was no such zone in fact and that the entire area, claimed by complainant to be embraced there-

in, was ordinary agricultural lands indistinguishable in its essential features from other agricultural lands in general within the state. Also that a considerable part of the lands in this zone had been improved and cultivated for many years.

The immateriality of this contention is attested by (a) the obvious departure from the matters alleged in the answer; (b) the incontestable physical conditions disclosed in the facts that the area in question was the confluence of the drainage of a watershed of some 750 square miles; (c) the negligible slope of the area; (d) the sinuosity, and at various points almost complete obliteration of the natural channels; (e) the total inadquacy of those channels to discharge flood waters; (f) the extended system of artificial ditch construction covering practically the entire area; (g) the necessity for and consequent creation of the new and artificial channel by the action of the state itself across the entire area, superceding and having far greater discharge capacity than the natural channel, and finally, (h) that practically every, if not every, witness summoned by Minnesota to attest this contention admitted the fact of periodic overflows of the lands in this area at the times of spring thaws and in periods of excessive precipitation.

2. That the recitals of the legislature of Minnesota, in the act providing for the construction of the Mustinka State Ditch, and attesting the necessity of its construction were untrue. It may be inferred it is contended there was no occasion for constructing the ditch and that there was no substantial office or function to be subserved by it in the area in question.

The immateriality of this contention is at once seen in the circumstances of (a) its total variance from the

pleadings; (b) its complete evasion of the obvious and incontestable physical conditions; and (c) its utter inconsistency with the conceded fact of the elaborate ditching system throughout the entire area involved, for which, independently of the Mustinka State Ditch, there was no adequate channel of discharge.

3. Closely connected with the features last above, it is contended that neither the main ditch construction nor the elaborate system of laterals had effected any appreciable change in the flood conditions in this area or contributed to the more rapid discharge of the flood waters therefrom.

The seemingly obvious answer to this is that (a) it negatives the existence of consequences which are the natural and necessary results of patent physical conditions and laws; (b) it assumes that an elaborate system of ditch construction, covering substantially the entire area of an extended flood plain and substituting direct artificial channels of greater capacity for indirect and sinuous channels of lesser capacity, is without efficacy in modifying flood conditions.

4. Following and supplementing the contention last above, an elaborate theory was attempted to be worked out on substantially the following lines; that Twelve Mile Creek which has its source as disclosed by the map, in the southern portion of the Mustinka watershed and its confluence with the main channel of the Mustinka River at a point in or near the northern part of what is termed the loop to the north, was the dominant stream. This stream was intercepted at practically right angles by the original ditch on the east and the extension or "cut-off" on the west. During periods of extreme floods, the flow of its waters was such as to carry them beyond the ditches

into the natural channel to the north around the loop, thus damming the flow of the waters through the ditch to the east, and minimizing the flow of the cut-off on the west. This flow, on the theory thus assumed, appropriated the entire capacity of the Mustinka channel round the loop and presented a fixed factor in the volume of discharge in Lake Traverse. Only the excess in the total discharge over the natural channel capacity could be ascribed to the ditch.

The answer to this is (a) it lacks the virtue of ordinary common sense and (b) is opposed to engineering principles of almost elementary conception. Consideration of matters pertaining to the engineering features of the case will, however, be considered in further detail later.

5. That the floods of 1915 and 1916 are accounted for by natural phenomena, including what is claimed to be the abnormal and excessive precipitation of those years.

Seemingly the only required answer to this contention is seen in the circumstances that (a) whatever may be assumed for the natural phenomena, there has now been added and superimposed on the conditions naturally resulting from such phenomena, an artificial condition directly contributing to increased floods; (b) that whatever hypothesis be assumed for the results of natural conditions, there must now be added thereto the constant and permanent factor involved in the artificial drainage which necessarily increases those results; (c) that in flood conditions, it is the higher levels, practically speaking, which produce and perpetuate disastrous consequences; and finally, (d) that there was nothing in the natural phenomena during the years in question, after the creation of the artificial ditch construction, substantially different from that existing in a series of previous years, when

flooding conditions of the character of those here disclosed were absent.

DISCUSSION OF THE EVIDENCE.

III.

GENERAL CONSIDERATIONS BEARING ON THE WEIGHT AND CREDIBILITY OF THE TESTIMONY.

In approaching the argument on a record of the magnitude of that here presented, the difficulty of determining the method of presentation best calculated to lessen the labors of the court, while at the same time elucidating the features decisive of the controversy, is apparent.

This record is presented to the court in a matter addressed to its original jurisdiction and involves, therefore, the consideration of matters of fact as well as of law.

Prefatory to consideration of the case from the standpoint of the facts, it is desired to direct attention to certain more general features for their bearing on what we may term the weight and credibility to be attached to the testimony.

1. It is a remarkable as well as significant feature in this case, that Minnesota, in its strenuous efforts to defeat liability, has found it necessary to practically stultify its own legislature and legislation. For convenience, we repeat at this point the preamble of the Act of 1911, designated as Chapter 138 of the General Laws of that state and entitled as follows:

"AN ACT TO AUTHORIZE THE STATE DRAINAGE COMMISSION TO CONSTRUCT AN OUTLET FOR THE WATERS OF THE MUSTINKA STATE DITCH IN TRAVERSE COUNTY, MINNESOTA, AND TO APPROPRIATE MONEY THEREFOR."

"Whereas, a special committee consisting of five members of the house of representatives of the legistive session of the year 1909, duly appointed under the resolution of said house duly adopted, and which authorized the appointment thereof for the purpose and which was duly empowered to administer oaths and take testimony of certain petitioners, seventeen in number, and others, in relation thereto, after taking such testimony, duly found and reported to said house that upwards of eight thousand acres of fertile farming lands in Traverse county, Minnesota, including the lands of the said petitioners, situated adjacent to the Mustinka river in said county—previously under cultivation for about thirty years and during that time never overflowed—in the crop seasons of the year 1897 to 1908, were overflowed by overflow of the said Mustinka river; that such overflow of the said lands of the said petitioners and others during the said years, destroyed crops of the said petitioners to the value of $28,302.00 and depreciated the value of the said lands overflowed, including the lands of the said petitioners, to an amount equal to the difference between forty dollars and fifteen dollars per acre; that said overflows of the said river occasioned by and resulted from the construction of the Mustinka state ditch which was constructed by the State of Minnesota, during the years prior to 1896, but completed in said year, in order to drain lands situated in Grant county, Minnesota, then owned by the State of Minnesota, so as to make the said lands fertile, valuable and saleable, and for no other purpose; that the overflow of the said Mustinka state ditch is into the said Mustinka river whose channel is inadequate to take care thereof; that such overflows of said Mustinka state ditch and said Mustinka river have occurred each year since the construction of said ditch at times of rain or melting

snow and will continue each year unless an adequate outlet for the surplus waters, brought to said Mustinka river as the result of the construction of said Mustinka state ditch, is constructed; that the waters which overflow lands in the vicinity of said Mustinka river collect in pools at various low places therein and become stagnant and a condition is thus created which is detrimental to the heatlh of the people residing in the vicinity of the lands so overflowed and the same constitutes a menace to the public health and a public nuisance, in addition to being a private nuisance and injury to all persons owning lands overflowed thereby or residing in the vicinity of such overflowed land; that the nature of such injury and nuisance is such that if caused by the act of an individual could and would be abated by action in the courts and damages recovered therefor; that it is feasible to construct an adequate outlet for the waters of said Mustinka state ditch or for the surplus waters of said Mustinka river so as to abate said nuisance and injury and so as to prevent injury to the health of the inhabitants of the vicinity of said ditch and said river and to promote public health, at a cost of about thirty-five thousand dollars ($35,000.-00.)"

In the same connection, attention should be directed to defendant's Exhibit No. 5. The Findings of the Legislative Committee, (Record 2169) in which the following findings, amongst others, were made:

"1. That along and adjacent to the said Mustinka river in said Traverse county, there are upwards of 8,000 acres or more of good first-class, tillage farming lands, which have been all under cultivation, and have in years past, produced large crops of wheat, oats, flax, hay and other small grains.

2. That prior to the year 1897, no part of the said lands were ever, since the settlement of that part of the said county over thirty years ago, overflowed, and no crops thereon damaged or destroyed by the waters of the said Mustinka river, but on the

contrary, said lands in said years, were all among the most valuable farms in said Traverse county, and the rainfall in said county and the territory drained by said river, in the years prior to 1897, and particularly in the years 1880, 1881, 1882 and 1883, was as heavy, extensive and excessive as in any year or years subsequent thereto.

3. That in the years 1894 and 1896, a certain drainage ditch extending from a point in Section 20, Township 128, Range 4, in Grant County, Minnesota, thence westerly about 6½ miles, to the point where the so-called "Twelve Mile Creek", a fork of the said Mustinka River, crosses the Section line between Sections 18 and 19 in Township 128, Range 45 in said Traverse County, was constructed by the State of Minnesota, to drain its own lands in said Grant County.

4. That the said Mustinka State Ditch heretofore referred to, and so constructed by the State of Minnesota, diverted and conveyed into said Mustinka river, waters that theretofore naturally flowed northward and emptied into Rabbit river, and which waters before the construction of said ditch never found its way into the said Mustinka river.

5. That the said ditch runs thru low, flat and marshy country in said Grant County, resulting in a large flow of water thru said ditch into the said river, and by reason of a large volume and rapid flow of the waters in said ditch, it caused to be conveyed into said river more than the said river could receive and carry off within its channel.

6. That in the years 1897, 1899, 1900, 1903 and 1905, 1906, 1907 and 1908, the said Mustinka State Ditch conveyed into the said river such large amounts of water that the said river in each of said years, after the crops on the lands hereinbefore referred to, had been planted and were growing, overflowed its banks and flooded the said lands and destroyed most of the crops growing thereon."

It should be observed at this point that the references made in foregoing Findings and Preamble were to the

construction of what is termed in this record, the original Mustinka Ditch and the effects produced by the construction of that ditch on the general area of the confluence. It should be further observed that the area of 8,000 acres, therein mentioned as overflowed as a result of the construction of this original ditch, was outside of the area which the complainant has designated as the delta zone, or, in other words, west and south of that zone along the channel of the Mustinka River as the latter flows to its outlet in Lake Traverse. Rec. 2129 (3506.)

The situation thus indicated practically confirms the contention of the complainant in this case.

Previously to the construction of the original ditch, the flow of the concentrated and accumulated waters of the confluence was so far limited by the natural conditions and the inadequate capacity of the outlet through the Mustinka River, that the volume of the waters reaching that channel was insufficient to result in its surcharge or to overflow area mentioned. The original ditch naturally tended to concentrate the flow and transfer the waters in greater volume to the west—thus nearer to the point of ultimate discharge and to surcharge the lower reaches of that channel with the consequent inundation of the new area thus referred to.

These conditions further confirm what is attested by the general "lay of the land" and contended for by complainant in this case, viz: that the area of the confluence (the delta zone) was a natural detaining basin retarding the flow of the flood waters accumulated therein.

When the original ditch was constructed, this basin was in part destroyed; the accumulated waters were transferred as already stated to a point further west nearer the outlet, with the result of transferring the burden of

the overflow to the area further down stream.

See testimony Ralph, Rec., 312 (461) 313 (462, 463).

The resultant effects were the improvement of one area by the injury of another. Both, however, were within the limits of Minnesota. When complaint was submitted to the legislature of that state, on behalf of those who sustained the burden of this change, relief was provided by extending the artificial construction and again transferring the burden below. As in the case of the original ditch, no consideration appears to have been paid to the resultant effects of the new construction, other than respects the area immediately benefitted. In other words, Minnesota gave no heed to the consequences, content with affording relief to its own local area.

The new construction completed the destruction of the original detaining basin in the delta zone. The sequel discloses a repetition of what had happened before, viz: of casting the burden on an area lower down—in this instance, the Valley of the Bois de Sioux

2. Upon analysis of the details, it will be found that there is no material discrepancy between the data employed by the experts of the respective parties. The differences arise in the conclusions deducible from that data and the opinions predicated thereon.

The ultimate question for decision was, of course, determining and assigning the cause of the floods. In the determination of this question scientific features necessarily arose calling for the solution of experts qualified by experience and otherwise in the sciences involved. On behalf of the complainant, as already stated, there were called on this branch of the case, witnesses of unquestioned qualification and wide experience in the scientific as well as practical features of the subject of flood control

and drainage.

The witness Ralph, as already stated, had been the State Engineer of Minnesota in general charge of the drainage work in that state from 1900 to 1913. The area in question had been under the practical observation of this witness for many years during which he had had the opportunity of studying and familiarizing himself with the whole problem of drainage involved. Rec., 302 (445) 303, *id.*

In Dean Shenehon, the complainant produced a witness whose prominence in the engineering field and long experience entitles his conclusions to the respect ordinarily accorded those emanating from eminent authority.

In Professor Chandler, the complainant produced a witness of exceptional experience and knowledge, particularly with respect to flood phenomena and their attendant incidents.

These authorities were agreed in assigning the cause of the floods in question to the destruction of the natural detaining basin in the delta zone by the artificial drainage constructed through this zone by Minnesota.

The reasons for these conclusions were fully amplified.

See Ralph, Rec. 320 (474), 321 (475-476.)

" Shenehon, Rec., 463 (707), 464 (708).

" Chandler, Rec., 519 (801), 520 (802).

It is a significant circumstance and one which will not fail to impress the court that the main reliance of Minnesota in opposing the testimony thus mentioned, is rested with the theories and opinions of the witness Frederick H. Bass, alone. Prof. Bass is a member of the faculty of the University of Minnesota.

It is not pleasant to record in this brief anything which could be construed as in any wise deprecatory of Professor

Bass personally, for whom counsel for complainant entertain nothing but the friendliest feelings.

We must, however, record our emphatic protest with respect to his expert qualifications. The present record discloses he is almost totally—we might say totally, lacking in practical experience in the subjects determinative of this controversy. In the general field of flood control, drainage, etc., etc., his opinions must be regarded and weighed as those of a pure theorist, wholly lacking in the knowledge which comes from practical experience. Rec. 814 (1270.)

3. In ordinary cases where important and material testimony is available for one or the other party to a dispute and is not produced, something akin to a presumption arises that the failure of its production proceeds from the circumstances if produced, it would have proven detrimental. The situation disclosed by this case seemingly justifies the application of that rule. With the entire engineering faculty of the great state university of Minnesota available, including therein men of national prominence in the sciences here involved, Minnesota contented itself with presenting as its single expert and practically resting its case, with a Professor of Municipal and Sanitary Engineering, whose experience, even in the limited field indicated by the title stated, appears to have been almost exclusively confined to the class room.

Minnesota similarly failed to call Mr. E. V. Willard who succeeded Mr. Ralph as its State Drainage Engineer. Comment under such circumstances seems superfluous.

4. In referring to the expert testimony offered by Minnesota, we have thus far omitted reference to that given by one Frederick William Sardeson, a geologist by profession. The standing and eminence of this witness is

perhaps sufficiently attested by the circumstance that, after remaining for some fifteen years as an instructor in geology in the University of Minnesota, during which period he failed to reach a full professorship, he was permitted to retire from its staff. Rec. 875 (1352), 878 (1356.)

This witness was wholly without qualification as an engineer [Rec. 879 (1357)] and his conclusions with respect to the causes of the floods in question are of no material value.

After the testimony in this case was closed, our attention was directed to an article in the August, 1917, issue of the Western Magazine published at St. Paul, Minnesota, entitled, "The Drainage Question" by Professor F. W. Sardeson. We excerpt the following quotation on the assumption that "Professor Frederick William Sardeson" and "Professor F. W. Sardeson" may fairly be assumed to be one and the same:

> "For example the high flood in the Red River Valley in 1916 was caused in large part by drainage conditions there. The ground had become filled to saturation by previous rains, so that when the storm came practically all the water that fell flowed off and rushed through *open drainage lines to the flat valley*. If the country had had tile drainage instead of many open ditches, the water from previous rains would have been drained out meanwhile from the ground, so that at the time of the storm the soil could have taken up a large part of the rain and to that extent held back the flood thus decreasing its intensity. *As it was, the flood's height was far out of proportion to the amount of the rainfall*" (Italics ours).

The foregoing is not cited as a reference to scientific authority on the subject involved but rather as indicative of the comparative ease with which opinions emanating from certain sources may be materially modified.

5. In conclusion upon these general features, it is claimed by the complainant that Minnesota's defense in this case proceeds largely on an attempt to reverse facts and conditions, the existence of which it has already attested by the solemnity of the declarations of its own legislature. That it has attempted to evade just responsibility by the promulgation of complicated and untenable theories, born largely of the imagination and inspired by doubtful authority. That it has failed to call available witnesses qualified to speak from experience with the subjects determinative of the issue. That such failure is ascribable to no other reason than the fact that such witnesses would not attest the complicated and impractical theories on which Minnesota relies in this case. That the physical condition are incontestable and entirely consistent with the opinions expressed by the experts of complainant and so obviously inconsistent with those expressed by the single expert of the defendant as to leave no reasonable room for doubt which of these diametrically opposed theories is correct. Under these conditions the complainant contends that the preponderance of the evidence is so manifestly in its favor as to remove the ultimate issue from the realm of doubt.

IV.

General Survey of Complainant's Evidence covering Flood conditions complained of and the causes thereof.

It may serve to lessen the labors of the Court in reviewing the mass of matter incorporated in the present record if a general survey of the details be had at the outset. This

method will also serve to disclose and direct attention to the essential points in dispute as well as the portions of the record bearing thereon.

With the salient features thus expounded and their bearing explained, we shall approach their detailed consideration later on with clearer understanding.

(a) As the witnesses make frequent reference in their testimony to the map, Exhibit "A," attached to the Bill, a brief explanation of the matters there disclosed as well as of the various terms employed by the witnesses in referring to particular features will prove of assistance. This map, it will be observed, covers the territory in the southeast portion of North Dakota and the northeast portion of South Dakota with the bordering area of Minnesota involved in this case. In the southwest section is shown Lake Traverse with what are known as Mud House and Club Lakes, all whereof are generally designated and referred to on the present record as Lake Traverse. The dividing line between the state of North and South Dakota is shown one mile North of the village of White Rock.

Mention is made of White Rock for the reason that it is frequently referred to at various places in the evidence.

The outlet of Lake Traverse in the Bois de Sioux River is located at a point several miles south of White Rock. Following the Bois de Sioux north from White Rock for a distance slightly exceeding nine miles, appears the village of Fairmount in North Dakota, west of the River and approximately two miles therefrom. North of Fairmount extending easterly across the River and continuing through Minnesota are shown the tracks of the Great Northern railroad. Approxmimately a mile and a half north is a public highway crossing not shown. These points are respectively referred to by the witnesses as

the Great Northern bridge and High bridge in explaining various data and calculations.

The heavily shaded yellow portion of the area in the state of North Dakota and South Dakota, West of the Bois de Sioux River embraces substantially the area disclosed as flooded in this case.

East of Lake Traverse and the Bois de Sioux River is disclosed with heavily shaded yellow outline, the area of the Mustinka watershed, in Minnesota.

The irregular heavily shaded portion of this watershed to the east with the closely drawn contour lines is that referred to in the Bill and by the witnesses as the moraine zone. It will be observed that the main Mustinka River has its source in the northerly portion of this zone with numerous streams and tributaries flowing into it from the southern portion thereof. Also, that in Sections 19-20 21-22-23, etc., Town 128, R. 44 that the Mustinka River turns and flows practically due West. In Section 21 it is crossed by the Great Northern railroad at a point approximately a mile and a half from the village of Norcross, the location of this crossing and of the village last mentioned being frequently referred to in the testimony.

Just east of the crossing is disclosed an area heavily shaded in blue having an area of approximately seventy square miles. This is the area referred to in the evidence as the delta zone.

From the southerly portion of the watershed, two main tributaries of the Mustinka are disclosed known as respectively Five Mile and Twelve Mile Creeks. The former enters the delta zone in Sec. 19, T. 127, R. 44, and follows an irregular course slightly west of north to its point of confluence with the Mustinka River in Sec. 8, T. 127, R. 45. Twelve Mile Creek is shown as the westerly boundary of the delta zone running substantially due north and

The data thus prepared gives the requisite information with respect to the subject of precipitation for the present case. Rec., 455 (693).

Explains the various routes followed by him in his investigations. Rec., 455 (694).

The watershed is substantially as indicated on Mr. Ralph's map (Exhibit "A."). Rec., 456 (694).

The drainage of this watershed is into Lake Traverse and thence into the Bois de Sioux River excepting certain portions entering the River direct. Rec., *id.*

The Bois de Sioux has a narrow, shallow saucer shaped channel. There was very little flow when I was there, 60 or 70 second feet. The banks are low, especially on the Dakota side; those on the Minnesota side are fairly close and higher. The land on both sides of the river has a low line. It rises more rapidly on the Minnesota side and is fairly flat on the Dakota side. Rec., 456 (695).

The flow is with the slope of the land to the north. The water surface slope from Lake Traverse to White Rock is about 3 feet and from White Rock to the High bridge, the low water slope is about 9 inches to the mile. A mile and a half north of the High bridge, the slope is about 3.3 to the mile. Rec., 457 (696).

In what is termed the moraine zone, the land is rolling with considerable elevation above the delta zone. The Mustinka River flows through this moraine zone with a well marked fall. (Rec., *id.*)

In its natural state where the river turns and flows west, it passes through a flood plain; that is, a plain of very low slope where the river shows its indecision by its windings and where, in times of plentiful water supply, it leaves its banks. The slope is so slight that the water does not cut itself an adequate channel. Rec., 457 (697).

Examined the natural river channel north of Norcross; also, the original state ditch and some of the channels which the river previously followed. Rec., *id.*

The natural channel at this point which was superseded by the old state ditch may have had a surface width of 80 feet and a depression of perhaps four or five feet. The land itself is very flat and the channels are inadequate. This results in wide overflows. Its necessary effect is the accumulation of the waters over some area at the conflu

ence of the various streams, the Mustinka itself, Five Mile and Twelve Mile Creeks. Rec., 458 (698).

At the confluence in a state of nature, a detaining basin was created by the inadequacy of the Mustinka channel so that the waters that were due to enter Lake Traverse or were tributary to the Lake, were detained and in part, lost by evaporation and possibly by seepage and other causes. Rec., 458 (698).

The physical conditions indicated by Mr. Ralph's map and my observations of the conditions on the ground indicate that the overflow of these lands, the concentration of the waters there in a state of nature, was inevitable. Rec., 458 (699).

Such a basin would necessarily retard or detain the waters and they would be somewhat slower in reaching Lake Traverse. Rec., 459 (699).

In its natural state, the outlet of this detaining basin was the Mustinka River. Rec., 459 (699).

I observed the character of the ditch construction, including the original ditch and the extension sufficiently to express a general idea of its capacity as compared with that of the river channel in the latter's natural state. Rec., 459 (700).

Lake Traverse is the receiving reservoir for the waters brought down by the Mustinka River and acted as a secondary detaining or retarding basin in preventing floods in the Bois de Sioux River. That is, when the waters flow into the Lake, they are not immediately discharged. They must first be lifted above the level of the outlet. The Lake, in its natural state, is just such a detaining basin as engineers are obliged to create now-a-days artificially to take care of flood conditions on rivers. This is now accepted practice in flood control and is being carried on in different sections of the country. Rec., 461 (703).

In the area in question, we thus had two detaining basins in a state of nature; first, the delta zone, and second, the Lake. The action of these two basins was to minimize floods in the Bois de Sioux. Rec., 461 (704).

The construction of the Mustinka State Ditch tended to destroy or lessen the effect of the delta zone as a detaining basin. It also materialy increased the volume of discharge and accelerated the time of discharge of the waters into Lake Traverse. It also impaired the effect of

Lake Traverse as a detaining basin. Rec., 462 (704-705).

The reason for this effect on the Lake is that the tendency of the ditch is to lift the mesne level so that when a flood comes, it lacks its proper capacity as a detaining basin. To illustrate, the artificial basins constructed in the Miami River to control the floods in the vicinity of Dayton, Ohio, may be referred to. These basins or reservoirs, if full, would be valuable for waterpower, but for purposes of flood control, the object is to keep them as empty as possible so as to provide capacity for the flood waters. In the case of Lake Traverse this capacity has been impaired by the ditching operations referred to. Rec., 462 (705).

The general character of the land at the confluence of Five and Twelve Mile Creeks with the main Mustinka was such as to have had considerable effect as a detaining basin. Cutting the ditches through this area released the detained waters and created the flood conditions in Lake Traverse and the Bois de Sioux River. Rec., 462 (706).

By flood conditions we mean a higher level than comes each year with the spring break-up. There may be some little flood every year produced largely by natural causes of which precipitation is the predominant element. Rec., 463 (706).

In my judgment, nothing is disclosed in the meteorological conditions of the years 1915 and 1916, to account for the floods in question (Rec., 463-707).

In response to the hypothetical question based on conditions as described in the evidence and the witness' own observations, the witness stated that the cause of the floods in 1915 and 1916 was the ditching operations in the state of Minnesota, referring to the whole system as observed on the ground and as disclosed by the map of Professor Bass. Rec., 464 (708).

The witness further stated that he would make the same answer to the hypothetical question basing his answer exclusively on his own observations. Rec., 465 (709).

The reasons for this opinion were that the ditch construction had increased the run-off from the area involved. This increased run-off in time of flood was, in the opinion of the witness, about 50%. The waters were precipitated more rapidly into Lake Traverse during the flood period

and the Lake itself had had its storage capacity impaired. Rec., *id.*

The witness included in his answer the effect of the ditching through the delta zone which permitted the waters to enter Lake Traverse in a materially lesser time as well as in greater volume, which, of course, is involved in getting the waters there in less time. More is going per second or per day. The volume is also increased by the water that was formerly lost through evaporation and other causes in the delta zone. Rec., *id.*

There was also taken into consideration, certain calculations of the volume of flow in the Mustinka River based on measurements by the Geological survey, near Wheaton, in 1916 and 1917. These however, had been employed as confirmatory of the opinion expressed, based on matters of the witness' own observation. Rec., 465 (740).

If the Mustinka ditch construction is continued, it is inevitable there must be in the future, floods of greater range than those of 1915 and 1916. This ditch will be the producing cause of such floods whose operation will be extended by reason thereof and of the impairment of the detaining basin. In other words, if the ditch is continued, greater floods and of longer duration are to be expected in the future in the Bois de Sioux Valley. Rec., 466 (711).

The cross examination of this witness developed substantially the following facts: The normal level of Lake Traverse varies from 973 to perhaps 976. Our levels taken in June, showed 973.86. Mr. Ralph's levels taken during the flood period indicated 977. I would consider 974 a very reasonable mesne. This ditching construction will lift that mesne from three to six inches, say 974.33. Rec. 466 (712).

With the precipitation from Nov 1st, 1915 to April 6th, 1916, this elevation was increased to 977. I do not assume the precipitation every year will equal that of this period. I have made no reductions with reference to the yearly average of precipitation which is about 24 inches.

The precipitation in the period mentioned was about 48% above normal; that is, the normal precipitation should be 3.58 inches, as against the actual precipitation of 5.26 inches or a difference of 1.23 inches for five months. It is not necessary that there should be a material increase in this precipitation to produce a repetition of the flood

conditions. Other elements enter in, such as the condition of the level of the lake as a detaining basin. Rec., 467 (713).

Assuming we start with the Lake at the new mesne level resulting from the ditch construction, no accurate prophecy could be based on the single factor of increased rainfall as this loses sight of the run-off. The same rainfall might produce twice as much run-off under certain conditions as it would under others. I wouldn't undertake for a minute to predict the amount of run-off from a watershed. I undertake to predict with a degree of certainty the recurrence of these floods in the Bois de Sioux Valley because of the average conditions which are bound to come about and are recognized by all engineers as inevitable when a detaining basin is removed. For instance, if the two Dakotas and Minnesota should cut a ditch draining Lake Traverse, there is no question about the flood conditions we would have in the Bois de Sioux River. Those things are certain. They are axiomatic even. Rec., 468 (714).

I am not figuring on the rainfall remaining normal. In predicting the recurrence of these floods I assume we will have much greater rainfall than we have had in the past ten years. This will produce a great flow which will be very much accelerated by reason of this ditch construction over what it would be in its absence. The rainfall will not remain at any stated point. It will be greater in some years and less in others. It will follow very close to the average of the past decade or twenty years. In other words it will be about 35% less than the precipitation between November, 1915 and April, 1916. Rec., 468 (715).

We will have flood years, years of plentiful precipitation and other conditions favoring run-off when the axiomatic effect of this ditch in the state of Minnesota will be to make higher floods than would exist in its absence. Rec., 469 (716).

Precipitation is only one of the elements involved. It is the dominant element. The months where there is an accumulation of snow and ice, followed by the break-up of Winter, have a great deal to do with flood conditions. All these are taken into consideration but whatever natural conditions exist, with the new artificial construction, we will always have a higher flood than that which would have existed in the absence of that construction and if no

flood occurs, we shall have a higher normal lake level in my judgment. Rec., *id.*

We have this one constant condition of water brought with a higher velocity. The natural condition is precipitation which is predominant.

Temperature conditions, sudden break-ups, etc., all tend to make floods. The nature of the watershed has an influence; likewise, evaporation. The wind aids evaporation. Saturation in some watersheds is important but had small influence in this case as the reservoir capacity of the soil is not large. Rec., 469 (717).

The soil here is underlain by a clay sub-soil. There is no perceptible water table and the bottom of the ditch appears to be giving out no water. The area is easily drained by evaporation because of shallow soil. The surface soil appears to present the accumulated effect of vegetable growth and the infiltration of silt. So far as the geological formation is concerned, the black soil is simply a mixture of the clay and vegetable matter. Its composition is such in its natural state that it will not absorb much water. Rec., 470 (718).

In addition to the natural conditions already mentioned conducive to floods, the distribution of rainfall is a very important factor, that is, whether it is accumulated into compact storms or distributed over extended periods of time. Rec. *id.*

In predicting the recurrence of floods, I assume the natural conditions in the future will not be materially different. Increased cultivation may lessen the run-off although that is problematical. The additional amount of water absorbed by breaking the soil is very small. Rec., *id.*

In March and April of 1914, we had an excess precipitation; also in October, 1913. In November and December, 1913, and January 1914, there was a deficiency of 1.2 inches. The excess of March and April was little more than 1.3. May, 1914, had a slight deficiency. June, an excess of 4½ inches. July and August, 2 inches deficiency. September, .6 of an inch excess. October, .2 and November and December .2 deficiency.

I imagine the soil was saturated in the spring of 1915. In fact, almost every spring. Rec. 470 (719), 471 (720).

The fall of 1916 and the spring of 1917 show some ex-

cess and I should say that in the early spring of 1917, the soil would have been saturated. Rec., 471 (720).

From November, 1916 to April, 1917, the excess above normal was 21%. From November, 1915 to April, 1916, the excess was 48%. When, however, we get into little quantities like these, percentages are rather confusing. Rec. *id.*

In the spring of 1917, we had floods on the lower Mustinka but not on the Bois de Sioux. We had 2300 second feet at this time in the Mustinka. The reason there were not floods in the Bois de Sioux was presumably because this excessive flow in the Mustinka did not last long enough or come down so early. 1917 promises to parallel 1910 with one of the lowest precipitations we have ever had. 472 (721).

The ditch construction superimposed an artificial condition on these complex natural conditions. There must be considered on the one hand this Mustinka watershed in a state of nature and on the other, it must be considered with this artificial situation, the other conditions being identical. Unquestionably we would get more water in the latter case. Rec., 472 (722).

I am unable to state whether the natural channel round the bend or the cut-off would open first in the spring. So far as the effect of the snow is concerned, it would be nearly an even thing. Rec., 473 (723).

Under certain conditions, the ditch construction may effect the capacity of the soil to absorb water. That is, where the soil is dried out it will absorb more. The difference would be very small. The flow of the ground water through the soil would be slow and evaporation fairly rapid. Academically, the ditch construction increases this reservoir capacity of the soil but not very considerably. Rec. 473 (724).

It is not true that the greater the amount of ditching in agricultural lands, the more uniform the delivery of water to the natural water courses. The soil absorbs more but the predominant thing is the time of excessive flow and the rapid precipitation of the water. Rec., *id.*

This ditching does not make the discharge of the waters from these lands either more uniform or gradual than in a state of nature. Their effect is a much greater precipitation of the waters in times of plentiful supply and to

carry more water in time of storms than would have gone down in a state of nature. They constitute a more rapid transportation system for the mobilization of the waters. Once the little quantity absorbed by the soil through saturation is disposed of, the transportation system takes greater masses of water down with greater rapidity and with greater volume. Rec., 474 (725).

My judgment of recurrence of these floods proceeds from the fact that the natural causes will remain the same and that new artificial conditions tending to produce floods have been created. Rec., 474 (726).

Assuming a level of 975 for the waters of Lake Traverse and precipitation 21% less than in 1916, I cannot answer the question as to the possibility of recurrence of the floods. The complex of things causing run-off is too intricate. Notwithstanding, a reliable opinion can be formed as to the recurrence of these floods because we have superimposed on this complex of natural conditions, this artificial influence, that engineers all know tend to create floods; that is, the removal of one detaining basin and the impairment of a second one. Rec. 475 (726).

Had the conditions in 1917, been the same as those in 1916, including temperature, winds, watershed conditions distribution of rainfall, etc., the only difference being a lesser per cent of rainfall of 21%, with Lake Traverse at an elevation of 975.5, we should have had floods in the Bois de Sioux Valley only a little lower than those of 1916. Rec. 475 (727.)

I am not flood forecasting except on the principles where we have enumerated conditions which tend to make an even flow and to obstruct flow. Rec. 476 (728.)

If the conditions existing in 1916 are reproduced starting with Lake Traverse at an elevation of 975.5, we will have a flood of greater magnitude than in 1916. The deficiency of 21% rainfall deals with so few inches as to bring the matter down to minute quantities, that is, in one season we have 5.26 inches and in the other, 4.35 inches distributed over five months or less than 1/5 of an inch per month. Rec. id.

The main condition calculated to bring about a recurrence of these floods is the ditch, which furnishes improved transportation for the water. The impairment of Lake Traverse, by making it easier for the water to get

down there from the watershed above, is the other. Rec. 476 (729.)

If we dredge through the Bois de Sioux River from two or three miles above White Rock, we would have still greater flood conditions because we should have destroyed another detaining basin. The only difference would be we should put the flood on the other fellow. That is what they did here, when they destroyed a natural detaining basin something like Lake Traverse. Rec. 477 (729.)

I have made no assumptions as to the area of the delta zone. I have examined the entire area, including the main Mustinka ditch and the laterals. The existing conditions, in my opinion, increase the run-off during flood periods substantially 50%. This increase in the run-off would amount to 800 cubic feet per second, which would necessarily involve a considerable number of square miles. The precise number I have not attempted to determine. There is a great stretch of country involved with an artificial condition for drainage resulting under the conditions disclosed in 1916, in an increased run-off of 50%. Rec. 477 (731) 478 (732.)

This area may approximate 100 square miles and reaches in my judgment, pretty well toward the head waters of Five and Twelve Mile Creeks. It forms a basin, though not a level basin. (Rec. *id.*)

Its lowest point is the outlet of the cut-off. The rim of the Mustinka River defines the slope there and also the northerly limits of this delta zone. Under natural conditions there may have been some flooding to the north but I am unable to determine the extent. There is some fall to the north and northwest and I imagine there was some flow in that direction in times of flood. Rec. 479 (733-734.)

The contours indicate a slope from the south toward the north of about five feet to the mile. The area itself may be termed a basin because it was a converging place for the waters which flowed from a comparitively large area.

The existence of this slope does not negative the existence of the basin. To illustrate: We have a flood basin between high bridge and White Rock notwithstanding the water is on a slope. The delta zone is similar. The water

is moving infinitely slowly across the land. In the place where it accumulates it made a bigger outlet and that is the detaining basin. Under natural conditions the back-up of the water was considerable. The discharge capacity of the streams was lessened on account of this back water condition, and there was no intervention by ditches. The natural channels were the only things which facilitated the discharge of the waters. Rec. 480 (735-736.)

The Bois de Sioux Valley is a detaining basin in its relation to the area further north. The Red River is the same. Wherever waters flow over the land to a point of convergence, with inadequate outlet, the conditions of a detaining basin obtain. Rec 481 (736.)

A slope of five feet to the mile is rather a vague thing in our minds. It is better to think of it as a slope of 1-1/8 inches in 100 feet. We can then understand more clearly the effect of such an area as a basin. The water coming over such a flood plain is moving slowly. To illustrate: The water between White Rock and the High bridge has a velocity of about 1/10 of a foot per second, —yet that water is much deeper than the flow over the delta zone. Rec. *id.*

It is unnecessary to assume any particular depth of waters in this delta zone. It may have varied from 1/6 of an inch up to 2 or 3 inches under various conditions. The shallower the waters the slower they would run and the greater would be the amount of evaporation. It makes no material difference in the run-off, whether the area is considered as prairie or cultivated land. The evaporation from the latter would be slightly higher. (Rec. 486 (737.)

Parts of this delta zone were susceptible of habitation and cultivation in a state of nature but I am unable to precisely define those parts. The lands in this area are more susceptible of cultivation since the ditch construction. Rec. 481-482.

Counsel for Minnesota then asked the witness in substance if the delta zone as shown on Mr. Ralph's map (Exhibit 1) had no existence in fact, his opinion would be the same, to which the witness replied that the conditions disclosed an area of 100 miles or more where the engineers of Minnesota had expended thousands of dollars to get rid of water; to make it more habitable and

the lands therein, better adapted for farming. These ditches were built for this purpose by engineers and it is to be assumed, have served their function in diverting the water from the area. If the ditches have performed their function, the water has gone somewhere and the receptacle was Lake Traverse. Rec. 483 (739.)

Draining the local ditches into the natural channel of the Mustinka River or Twelve Mile Creek would not have accomplished the result. The Mustinka channel would have been inadequate. Had the ditches drained into Twelve Mile Creek the results would have been similar, as that creek outletted in the inadequate channel of the Mustinka, which could not stand any surcharge from additional drainage. The cut-off and the old state ditch have made effective the network of ditches over this area. Rec. 483 (740.)

Under natural conditions, Twelve Mile Creek was subject to overflow at the confluence. The Mustinka itself was similarly subject to overflow both north and south in the vicinity of Norcross and also at the confluence with Twelve Mile Creek. Rec. 483 (740-741), 484 (*id*).

There may have been some overflow of the main river below the outlet of the cut-off, that is, between that point and Lake Traverse. There was a considerable flood plain at the latter point. The flood there this spring (1917) was very brief and due to the concentrated waters in the delta zone being carried down suddenly. (Rec. *id.*)

There may be a concentration of waters, with some flooding of the delta zone, under present conditions. The periods of such flood should be short. With a better outlet, the waters are being rapidly thrown off. Rec. 484 (742.)

The cut-off and rectification of the Mustinka mak. effective the ditching system tributary to Five and Twelve Mile Creeks. In other words, the cut-off and rectified channel transferred to Lake Traverse the waters which under natural conditions would have been concentrated at the confluence. Rec. (*id.*)

If the Mustinka ditch were to be destroyed, that is, if conditions were restored so that they would be the same as before the ditch was constructed, the result would be to produce the lingering condition of the waters—a surcharged condition near the loop.

This would continue over a long period of time and the waters would get to Lake Traverse more slowly. Rec. 485 (743.)

Without the main ditch construction, the conditions would be worse at the confluence. I am not able to determine how far the back-water effect of the floods would extend. I assume this main ditch was constructed to provide for these conditions and that it serves its purpose. I also assume that in a state of nature, the natural channels would not have discharged the waters either with the same rapidity or same volume. The present artificial conditions provide a better outlet which would be destroyed by restoring conditions to their former state. Rec. (*id.*)

As to the flood plain west of Norcross, the construction of the original ditch was doubtless to drive the water a little further down, thus improving the lands to some extent in the vicinity of Norcross. I do not conceive there was any large flow into the Rabbit River even in times of flood. I think it carries substantially the same amount of water now as it did originally. Rec. 486 (744.)

The general plan of draining this area appears to have been correct. My preference for this plan over that which would have resulted from draining the area into the Rabbit River, arises from the fact that under the present system, Lake Traverse furnishes a natural detaining basin and thus tends to save the lands further down. Rec. 486 (745.)

I examined the lands between the confluence of the Rabbit with the Mustinka River and Wapheton and saw no indication of any large overflow in that area. Rec. 487 (746.)

In answering the hypothetical question, I assumed that approximately 600 square miles was tributary to the upper Mustinka. Excluding 20 square miles which were excluded by Mr. Ralph between Lightening Lake and the Mustinka, the drainage area east of the Great Northern is 283 square miles as computed by Professor Chandler from both Mr. Ralph's and Mr. Nelson's survey. The additional area above the outlet of the old state ditch makes the total 600 square miles or 580 square miles with the deduction above mentioned. Rec. 487 (747).

I have not separated the areas tributary to Five and Twelve Mile Creeks. The total area above the cut off is

computed by Professor Chandler from Mr. Ralph's survey as 628 square miles and from Mr. Nelson's survey, 721 square miles. The total area tributary to Lake Traverse and the Bois de Sioux River below the Rabbit River, we compute as 749 square miles from Mr. Ralph's and 861 from Mr. Nelson's surveys. Rec. 487 (747.)

The additional area is computed from Mr. Ralph's survey as 258 square miles and from Mr. Nelson's survey, 175. The total tributary area is, therefore, according to Ralph's survey, 1030 square miles and to Nelson's survey, 1304. Rec. 488 (748.)

Based on the data furnished by Mr. Ralph, at flood stage in the Bois de Sioux we estimate the level of Lake Traverse at 977. Rec. (*id.*)

The influx of water from the artificial construction described, in the summer of 1915 and the spring of 1916 caused the floods complained of. I have not computed how much the 50% increase in run-off raised the lake in 1915. Rec. 488 (749.)

It raised the Lake about ten inches above what it should have had under natural conditions in 1916. The area of the Lake is about 30 square miles under flood conditions and about 20 square miles overflow area from below White Rock to the vicinity of the High bridge. A flow of about 800 cubic feet per second extended over a period of ten days would account for this rise in the Lake's level. This excess water, in my opinion, would have remained upon the land—that is, over the whole area involved and not have reached Lake Traverse under natural conditions. Rec. 489 (749-750.)

In expressing my opinion, I have considered the ditch construction, which was made effective by the original Mustinka ditch and the new cut-off as a whole. I am unable to separate the increased run-off into the part that is ascribable to the main ditch and that ascribable to the various laterals. I think of the whole thing as a web made effective by the cut-off and the rectification of the Mustinka River. Rec. 489 (750.)

On re-direct examination, the witness stated substantially as follows:

In referring in my previous testimony to the rectified Mustinka channel, I had reference to the state ditch construction from the mouth of the old state ditch to Lake

Traverse. What I have termed the Mustinka state ditch presents itself to my mind as involving three elements—the old state ditch, the cut-off and the rectified river, below the cut-off. The cut-off is the portion of the ditch extending for a distance of about two miles and cutting off the loop in the Mustinka River to the north. Rec. 490 (751-752.)

In a slope of one foot to the mile, we would have substantially a slope of one-quarter of an inch in 100 feet. With a slope of five feet to the mile, it would be about 1-1/8 inches. Rec. 491 (752.)

The new artificial construction has a substantially higher carrying capacity than the original river channel. Rec. (*id.*)

In answering various questions on cross examination which assumed an elevation of Lake Traverse of 974.33 and precipitation between November and April exceeding the normal by some 22%, that it would be difficult to predict flood conditions owing to the complex of run-off, etc., I meant that while the various natural elements render it difficult to forecast floods, a modification has been brought about in this watershed, the inevitable effect of which must be to increase the flood level. Rec. 491 (753.)

Averages of precipitation taken over arbitrary periods like six months, furnish no criteria of flood conditions which depend on the distribution of precipitation and a variety of other conditions. To illustrate: In 1913 the flood in the Ohio River was caused by a precipitation of nine inches in three days. The same amount of precipitation spread over a month might have had no such effect. The precipitation taken over a series of months may be normal and yet, an excessive precipitation within some limited period of that time, might produce floods. In answering the questions on cross examination as to my reasons for predicting a recurrence of these floods, I stated in substance that the natural causes would remain while new artificial conditions had been created. Rec. 492 (754.)

In my answer to the effect that the flood of 1916 was caused by flow of about 800 second feet continuing for ten days which would have remained on the land in a state of nature, I meant only that this amount of water would

not have reached Lake Traverse within the ten day period. The precipitancy is the element in the balance. Rec. 492 (755.)

On re-cross examination, the witness stated substantially as follows:

My judgment is that notwithstanding the precipitation of 1915-1916, the level of Lake Traverse would not have reached a stage higher than ten inches below that actually reached but for the ditch. Rec. 493 (756).

If it were true that Lake Traverse had at some previous time when the natural conditions existed, reached as high a stage as they reached during the floods of 1915-1916, it would make no difference for the reason that whatever conditions exist naturally, we have now superimposed this artificial condition. That is, if the flood waters under natural conditions would raise the lake to an elevation of 977 the effect of the ditch construction, other conditions remaining the same, would be to raise it ten inches higher. It is wholly possible Lake Traverse may have reached the stage of 977 in earlier years under natural conditions and that those same conditions might account for a similar level in the future. Rec. 493 (757.)

I am not assuming any particular stage for the waters of Lake Traverse as accounting for the flood conditions in the Bois de Sioux Valley. I am assuming that the mesne level of the lake has been raised somewhat by the ditches and that this condition applies in times when the precipitation is not excessive as well as when it is plentiful. Superimposed on the natural conditions, we have the artificial conditions that add to the flood waters during short periods of time. We have the rapid precipitation of the waters from the watershed. Instead of coming down gradually as under natural conditions so that the capacity of the channels is adequate to handle them, the waters now come so rapidly as to cause the lake to fill and overflow. Rec. 494 (757.)

My investigations of the drift convince me that at the heighth of the flood the level of the waters in the Bois de Sioux Valley was about five feet above that which existed in May or June, 1917, near the high bridge. (Rec *id.*)

The backwater effect from the discharge of the Rabbit might have some influence on the conditions of the waters

in the Bois de Sioux River. The fact however that the Rabbit enters the Bois de Sioux at practically right angles is inconsequental in its effect. Whatever the conditions in this respect, they are a part of the natural conditions which have always obtained, upon which we have now these other artificial conditions imposed. Rec. 495.

I have assumed that the cut-off and rectification of the Mustinka channel caused a lower flood plain tending to lessen the flow of the flood waters from the Mustinka watershed into the Rabbit. On the other hand, there had been a little increase by the ditch construction tributary to the Rabbit. These conditions substantially offset one another so that I think the Rabbit carries substantially as much water now as before. Rec. 496.

In considering the element of backwater from the discharge of the Rabbit as effecting flood conditions in the Valley of the Bois de Sioux, it is important to consider that the waters of the Rabbit would reach the Bois de Sioux in much less time than the waters of the Mustinka which passed thru the lake detaining basin. The flood crest from the former would, therefore, pass before the conditions would be effected by the latter, so that it would be a very exceptional case where these results could be coincident. Rec. 497-498.

The contention that the ditching into the Rabbit River tended to make the flow more gradual is erroneous. The ditches have the opposite effect, viz: of precipitating the waters in times of large flood. It is the surface run-off that really counts.

Replying to a series of questions assuming that the area in the delta zone was largely settled with cultivated farms and inquiring whether such facts, if shown, would make any difference in his opinions, the witness responded that it would not. That the area was a flood plain and that all the indications showed that it had been flooded many times. Rec. 499.

This whole plain has doubtless been submerged at times. The lands therein are not all under cultivation even now. Rec. 500.

The channel of the old Mustinka from the outlet in Lake Traverse to the confluence with Twelve Mile Creek did not have well defined banks. At the confluence with the cut-off, the banks were low and the same was true

from that point down to about a mile above Wheaton. For a thousand feet above the confluence with the cut-off the channel was shallow and inadequate with lesser capacity than at the northern extremity of the loop. The building of the cut-off has tended to increase the channel capacity at the last mentioned point. Rec. 502 (771.)

Going up stream from Wheaton there is a flood plain which is not very extensive but where the river has overflowed its banks. The condition of a detaining basin in this area was relatively small. This area doubtless overflowed in 1915 and 1916. Below the Wheaton bridge there is no detaining basin feature. The elimination of the detaining basin above the bridge resulted from the rectification of the channel, thus getting the waters out more rapidly. Aside from volume, speed is the essential thing in dealing with floods. Rec. 503.

Independently of the ditching, the run-off would be more rapid from the moraine zone than it would be from the area tributary to Twelve Mile Creek. Rec. 505-506.

Roughly computed 40% of the total area of the watershed is tributary to the Mustinka River and 60% to the two creeks. Rec. 506-507.

The object of the whole ditching system was to lessen the flood hazard in the delta zone. Its effect was to increase the flood hazard on Lake Traverse and the Bois de Sioux Valley. Rec. 507 (781), 508 (*id.*)

I assume the object of the ditching was to make lands that were less desirable as farms more desirable for that purpose. I do not conceive any real value in this locality in the element of ground flow or the feature of tiling. (508 782.)

I did not take into account any future ditching operations or their possible effects in either Minesota or the Dakotas. Rec. 509 (783.)

I found no evidence on the Dakota side of any large flow. Rec. 510 (785.)

According to my computations, when Lake Traverse has an elevation of 977, about 1200 second feet is discharged into the Bois de Sioux. This would give a surface elevation at the high bridge of 966.5, or about one foot lower than the flood crest at high bridge in 1916. There is some contribution from the direct in-flow from either side of the Bois de Sioux which probably accounts

for about 200 second feet. When the lake is at an elevation of 976, the outflow is about 760 second feet. This would account for a flood elevation about 18 inches lower than the flood crest in 1916 and result in considerable flooding of the Bois de Sioux Valley. Rec. 510 (786), 511 (*id.*)

When the lake is at 975 the outflow is 420 second feet and the elevation at high bridge about 964.5 or three feet below the crest of the flood in 1916. At this elevation, there would also be a considerable overflow in the valley. At 974 the flow is 180 second feet which is approximately the amount of flow in June of this year, (1917) when there was no substantial flooding. Rec. 511.

(c) The matters thus elicited in the examination of Dean Shenehon are in substantial accord with those attested by the other experts called in complainant's behalf.

In the examination of Mr. Ralph, more stress was laid on his intimate knowledge of the conditions existing in the general area in question both before and after the introduction of the artificial drainage system.

In the case of Professor Chandler, greater emphasis was laid on those features with which he was peculiarly qualified to speak authoritatively, viz: the meteorological conditions in their relation under varying conditions to the run-off of the watershed affected.

The detaled review of Dean Shenehon's testimony has served the dual purpose of covering the general aspects of the case and to some extent—foreshadowing or drawing out the lines of contention relied on by the defense.

The latter discloses that main emphasis is laid on the following incidental questions, viz: (1) the existence of the delta zone; (2) the meteorlogical conditions in the years 1915 and 1916 as compared with previous years; (3) the comparitive carrying capacity of the artificial ditch construction, as compared with the original chan-

nels, for their bearing on the respective contributions to the ultimate discharge into Lake Traverse; (4) the run-off of the Mustinka watershed; and (5) the ditch construction as the cause of the floods complained of.

The obvious objective point in the several contentions thus suggested was to pave the way for what was proposed to be more fully expounded in the defendant's evidence, wherein the claims with reference to the several features thus enumerated may be stated substantially as follows:

(1) Notwithstanding the admissions of the answer; the obvious and incontestable physicial situation presented by the topography of the area; the declaration of its own legislature and the extensive artificial drainage disclosed it is contended that the delta zone had no existence in fact.

(2) That the meteorological conditions during 1915 and 1916 account for and explain the floods of those years and that the contribution to those floods by the ditches was at most negligible.

(3) Notwithstanding the admissions of the answer to the effect that the ditches had greater carrying capacity and superceded the natural channels, that the carrying capacity of the natural channels remained unimpaired and in fact exceeded the carrying capacity of the ditches. Predicated of this contention, recourse was had to the fallacy that in computing the volume of discharge at the outlet in Lake Traverse the natural channels should be first credited with their maximum discharging capacity and the balance credited to the ditches.

(4) That the run-off from the Mustinka watershed would not produce a sufficient volume of water to raise Lake Traverse to a level sufficient to account for the floods; and

(5) Postulated of these several contentions, that the artificial ditch construction in the area in question was a minor contributing factor instead of the primary cause of the resulting floods complained of.

Before considering the evidence of the defendant, bearing on these several contentions, a brief review of other testimony on the part of complainant than that already considered and having particular reference to several features thus enumerated, is desirable.

(1) The Delta Zone.

The testimony of Mr. Ralph disclosed that he had been familiar with this area since 1886; Rec. 302 (445) that he had had occasion to investigate it at various times in connection with his work as Minnesota's State Drainage Engineer covering the period from 1900 on; Rec. 308 (455) that the natural channels were wholly inadequate to provide for its drainage and in consequence, it was subject to periodic overflow; Rec. 309 (457) that the area thus affected was substaintially as shown in the blue shading in Complainant's Exhibit 1 (Exhibit "A" attached to the Bill) and its extent, approximately 75 square miles. Rec. 310 (457.)

This testimony was amplified on re-direct where reference was made by the witness to various complaints made to the State Drainage Board by settlers with reference to flood conditions. Rec. 440 (670.)

The channel of Five Mile Creek, several miles below its outlet was similar to the channel of the Mustinka. The channel of Twelve Mile Creek was better defined, particularly at its upper area, near the confluence. Rec. 310 (458.)

The testimony of Professor Chandler was to the same

effect. The channel of the Mustinka River west of the Great Northern crossing was almost indistinguishable. The banks were illy defined and the surrounding area substantially level. The channel was most poorly defined near the center, east and west, of the delta zone. Rec. 515 (794.)

The channels of Five and Twelve Mile Creeks were similarly inadequate. The necessary effect of these conditions was the overflow of the surrounding lands in times of high water. Rec. 516 (795.)

Referring to the area of the delta zone as disclosed on the map, a considerably larger area than that might be included in the flood plain and bore indications of periodic overflows. Rec. 536 (828.)

(2) The Meteorological Conditions.

Based on the precipitation records of the United States Weather Bureau of the various stations adjacent to the regions in questions covering a period of 15 years, Professor Chandler's testimony may be summarized on this feature as follows:

The year 1916 was not abnormally wet. In every period of ten or twenty years, there are several years of similar character, such, for instance, as 1905, 1908 and 1912. Rec. 521 (803.)

From May to September in 1905 the precipitation was 19 inches; for the same months in 1908, 19.4 inches; in 1912, 19.3 inches; in 1915, 20.6 inches and in 1916, 20.5 inches. Rec. 521 (804.)

In dealing with flood phenomena, consideration is not ordinarily had of precipitation covering periods as long as four or five months. It is the excessive precipitation

in short periods which reaches the channels before they are able to carry it away. Rec. 522 (805.)

In the area in question, flood conditions would be governed by precipitation over periods of from ten days to a month. Rec. *id.*)

In 1916 the highest five day precipitation was from August 19th to 22nd, 3.2 inches. The next highest, June 28th and 29th, 2.5 inches.

There was no other similar period in 1916 showing a precipitation above two inches. Rec. *id.*

In 1915, the highest precipitation during such period was June 26th to 28th, 2.3 inches. No other five day period in that year showed as high as two inches. Rec. *id.*

Taking thirty day periods, the greatest precipitation in 1915 was June, 7.4 inches. No other month showed over 4 inches. Rec. 522 (806.)

Taking the previous years with months of highest precipitation, the showing was as follows:

May	1905	5.9 inches
"	1906	5.4 "
June	1908	8.2 inches
July	1912	5.5 "
June	1914	10.4 "

During 1915 and 1916 the highest monthly precipitation was June, 1915, 7.4 inches.

In 1916 the highets monthly precipitation was May, 4.5 inches; June, 4.6 inches; August, 5 inches.

Taking two successive months, the showing was as follows:

June and July, 1915,	11.5 inches
July and August, 1916,	8.6 inches
July and August, 1912,	9.4 "
May and June, 1908,	12.9 "
July and August, 1906,	9.6 "

May and June, 1905, 10.5 "
June and July, 1904, 8.9 "
May and June, 1897, 12.2 "

There was nothing therefore, in the meteorological conditions preceding the floods of 1915 and 1916 to distinguish those years as respects flood conditions from the previous years mentioned. Rec. 523 (806-907), 524 (808.)

No comparison of the total annual precipitation of 1915 and 1916 with the annual precipitation of previous years had been made for the reason that was too long a period to be considered. Even with the inadequate channels, existing under natural conditions, in the watershed in question, they would accomodate a greater run-off than actually occurs, if the precipitation could be distributed evenly throughout the year. The conditions productive of floods are those resulting from excessive run-off during short periods, which surcharge the discharging channels. Rec. 524 (809.)

The meteorological conditions of 1916 were not abnormal as compared with those of 1904, 1906, 1907 and 1897. The Winter precipitation covering November, 1914 to March, 1915, inclusive, was slightly less than normal. That for the same period in the Winter of 1915-1916 was about 1½ inches above normal. Rec., *id.*

In the absence of the artificial conditions the precipitation of the winter months of 1914 and 1915 would not account for any unusual flooding of the Bois de Sioux Valley. The same was true of the winter months of 1915-1916. Rec. 525 (810).

To same effect see testimony of Ralph. Rec. 443 (674-675).

(3) THE CARRYING CAPACITY OF THE DITCHES.

But for the fanciful theory, attempted to be worked out by the expert of the defendant, with reference to this subject, further allusion to it would be wholly unnecessary.

Assuming, as it is natural to assume under the conditions here disclosed, that the necessity of artificial drainage in the area in question arose from the inadequacy of the natural channels with their almost total obliteration at certain points, the objective, from an engineering standpoint, in the artificial construction would be supplying what nature had failed to supply, with adequate carrying capacity for the accomplishment of this purpose. In other words, it is inconceivable that the engineers of the state of Minnesota would construct this vast drainage system for nothing.

As respects the original state ditch, Mr. Ralph, after stating its approximate dimensions, testified its capacity was far in excess of the natural channels. Rec., 312 (461).

Its construction resulted in concentrating the flow of the waters which would naturally accumulate in its tributary area and by reason of its greater depth and increased fall, transport those waters to a point further west. Rec. (*id.*)

This resulted in overflowing some six or eight thousand acres south and west of the delta zone, in the central area between the outlet of the present cut-off ditch and the southwesterly outlet of the Mustinka River in Lake Traverse. This area had not been previously subject to overflow. Such were the conditions and this the area referred to in the preamble of the Act of 1911 of the Minnesota legislature which provided for the extension of the original ditch to relieve these conditions. Rec., 2129 (3505).

With reference to the same features, Professor Chandler testified that the capacity of the natural channel in the area covered by the original ditch was practically zero; that the ditch was constructed in substantially a bee line to the west and that its carrying capacity was incalculably in excess of that of the natural channel. Rec., 517 (797).

For the purpose of comparing the relative carrying capacity of the cut-off with that of the original channel round the loop to the north, the mere casual inspection of the surface discloses the length of the cut-off as approximately one-third of that of the natural channel. With common points of inlet and outlet, the slope, and therefore velocity, in their bearing on the subject of discharge capacity would be correspondingly greater in the shorter distance. The comparative cross-sectional areas were disclosed by the plat prepared by Mr. Ralph. (Complainant's Exhibit 5, Rec., p. 154).

Mr. Ralph's testimony, on complainant's case in chief, may be summarized on this feature as follows: The cut-off had a bottom width of thirty feet; a side slope of one to one and a top width of from 50 to 60 feet for the first two miles. Its depth was approximately 12 feet while that of the natural channel was only about 5 feet. It was constructed in a substantially straight line. The natural channel was approximately 2½ times longer. The cut-off had a greater carrying capacity than the original channel for the reason it had much greater velocity. Rec., 315 (466).

The capacity of the channel, he computed at 1800 second feet. Rec. 351 (526).

The value thus assumed in the testimony of this witness for the maximum carrying capacity of the channel, exceeded the highest figure claimed by the expert of the de-

fense by some 300 second feet and the estimates of the other experts of complainant in a still greater amount.

The corresponding capacity of the cut-off was 2400 second feet. Rec. 350 (523-524.)

These computations were re-checked and verified on the rebuttal in refuting certain of the broadly academic theories propounded by the defendant's expert. Consideration of this feature may however be postponed to a later point.

Professor Chandler stated in substance that based on his own measurements he approximated the capacity of the cut-off at from one and one-half to twice that of the natural channel. That the turns of the natural channel, according to computations made by him from Defendant's Exhibit 4, disclosed from 6 to 8 right angles to the mile. That the length of the latter was slightly more than three times that of the cut-off. Rec. 518 (799.)

(4) The Run-Off of the Mustinka Watershed.

The questions on this feature of the case dealt with the accessions or contributions to the waters of Lake Traverse from the watershed in question. Incidentally, as far as the same could be computed, a comparison of the volume of discharge under natural conditions, with that existing after the artificial drainage system had been completed.

It will be recalled that Dean Shenehon approximated the increase in run-off from the construction of the ditches at 50% and that this would account for increasing the flood crest in Lake Traverse, over the highest level it would have reached under natural conditions, approximately one foot.

Mr. Ralph's percentages were slightly higher and his estimate of the increase in the flood crest in Lake Traverse was from one to two foot. Rec., 322 (477).

Professor Chandler's reasons and conclusions on this branch of the case are particularly important by reason of his peculiar qualification and exceptional experience with the subject matter. A summary of his testimony as given in the case in chief is as follows:

In expressing the opinion that the Mustinka ditch accounts for the floods in question, I assumed a run-off from the Mustinka watershed in a state of natuer, at not exceeding .5 to .7 of an inch per month from the entire surface of the drainage area, excepting in cases of cloud bursts or violent storms. This would be approximately from ½ to ¾ of a cubic foot per second, from each square mile of watershed, through the month. Rec. 544 (842.)

These figures are based on a comparison with all the other stations and streams in the Red River and Minnesota River valleys where records have been maintained by the government for a long period of years and local conditions vary somewhat according to topography. Some of the streams come from a country where the run-off is much less and some where it is greater than the Mustinka. The Otter Tail River is comparable to the Mustinka but with increased run-off owing to greater slopes. I have adopted intermediate figures between the Otter Tail and the Upper Minnesota and can produce, if wished, the records of those rivers to show that under no ordinary conditions, any greater run-off than I have stated exists. If a guaging station had been established on the Mustinka River near its outlet ten or fifteen years ago, the figures derived from this would be incomparably better than averages. A gauging station was established on the Mustinka

in June, 1916. Based on the actual readings at this station, the average discharge covering the period from June 6th, 1916 to June 6th, 1917 was approximately 207 cubic feet per second. Assuming the drainage area of the watershed above the gauging station at 776 square miles, the average discharge for the year would be .26 of a cubic foot per second per square mile. In estimating the run-off at from .50 to .75 second feet under natural conditions, I was estimating the maximum for a wet month. This .26 is the actual run-off over 12 months as shown by the readings.

In a state of nature, I would estimate this average for the 12 months at from .10 to .18. This for the reason that the rivers in this region in normal years do not receive in excess of two inches from their drainage areas or an average of about .15 of a second foot per square mile through the year. Rec., 544, 545, 546.

The resulting increase of run-off into Lake Traverse tended to keep the Lake at a higher level and destroy its value as a detaining basin. In the absence of guaging for former years, I am unable to measure this precisely. Notwithstanding, it unquestionably exists. Rec. 547 (847.)

My figures show with approximate accuracy, a maximum discharge at Wheaton of about 3500 second feet during the spring of 1916 and an average discharge for 10 days of approximately 2500 second feet. These figures are based on flood heights reported unofficially by residents, also, the recent measurements of Dean Shenehon with the rating table developed from actual current meter measurments and actual cross sections taken at the gauging station of the United States Geological survey. The high water stage, as unofficially reported, was from 15 to 16

feet higher than the low stage as observed by myself in June, 1917. The highest stage shown by the geological survey was 12½ feet above this low water stage which would give a discharge of 2300 second feet. The increase to 15 or 16 feet would disclose a maximum discharge of 3500 second feet. Rec. 549 (850-851.)

Under natural conditions, the discharge would not have exceeded 1500 second feet which would be an average run-off of 2 second feet per square mile. This is as great as any records I recall for such a country under natural conditions. I do not assume that a discharge of 1500 second feet ever existed under natural conditions but only that it could not have exceeded that amount. Rec. 550 (852-853.)

The importance of these computations is at once seen in the very material increase in the run-off under the artificial conditions, from what would have existed in the absence of those artificial conditions in a state of nature. Making allowance for errors in calculation, which might reduce the maximum discharge disclosed by the meter readings 10%, as stated by Professor Chandler, or from 2500 to 2250 second feet, and allowing the maximum based on the highest known run-offs in that section which materially exceeded Professor Chandler's estimates, we still have an excess of 750 second feet, which tallies verp closely with the computation of Dean Shenehon already mentioned.

That the values for the discharge under natural conditions, last mentioned, were too high and that the maximum should be taken at nearer 1000 feet is disclosed by Professor Chandler's estimates that the excess discharge due to the ditch construction was from 1200 to 1500 second feet. Rec. 553 (856-857.)

These figures were also checked and verified in the rebuttal. In the same connection the independent testimony of Mr. W. R. Powrie, one of the Engineers of Maintenance of the Chicago, Milwaukee & St. Paul Railway, was introduced as to the actual flood levels in 1916 at the point of discharge near Wheaton. The results computed on the basis of this level disclosed that the highest estimates mentioned in the figures thus far reviewed were over conservative and that the maximum discharge was probably quite materially in excess of the figures thus mentioned. This feature will be alluded to in more detail at a later point in this brief.

5. The Cause of the Floods.

This feature has been so fully reviewed in the matters already considered as to dispense with the necessity of further discussion at this point. It will necessarily be considered in the later examination and analysis of the theories of defendant's expert and may, therefore, be postponed to that point. Before leaving the matter however, it may be advisable to allude briefly to one purely practical feature.

Throughout the case, in the cross examination of complainant's experts, as well as in its direct evidence, the defendant has sought to make it appear that so vast a volume expressed in cubic feet, would be required to raise the flood levels a foot or more in Lake Traverse, that it was utterly incredible any such accession should be attributable to the excess flow from the ditch construction, over what would have existed under natural conditions.

The entire matter thus suggested is purely mathemati-

cal and the results therefore, demonstrable to reasonable certainty. This may perhaps be best visualized by the illustration of Professor Chandler on cross examination which was in substance as follows:

Assuming the run-off of 1½ inches from the entire area of the watershed in a month, if the water came in one mass and there were no outflow from the Lake, it would raise the elevation of the latter's waters approximately three feet. Under ordinary conditions as this run-off would reach the Lake gradually and at the same time a certain amount is discharging through the Lake's outlet, the latter's level would not be raised more than a fraction of a foot. With the inflow facilitated by the ditches, 2 or 3 inches from the watershed would flow into the Lake in a month and except for the fact that the Lake itself overflows and thus increases its own capacity, the in-flow would be sufficient to raise its level from 5 to 6 feet. Three inches coming into the Lake in one month would flood the lands in the Bois de Sioux Valley substantially to the extent they were flooded in 1916, raising the level of the waters of the Bois de Sioux at the high bridge to about 967. Rec., 531 (820-821).

Merely for the purpose of further visualizing without attempting to detail the various factors entering into the complicated problem, if we assume the increase in the discharge into Lake Traverse resulting from the ditches at 1200 second feet, (the low figure estimated by Professor Chandler) it is apparent that the total volume covering the ten day period would be computed by multiplying the unit stated by the number of seconds in a minute; that result by the number of minutes in an hour and the latter by the number of hours in a day, thus reaching the volume of daily discharge. This sum multiplied by ten days

(the number in which the maximum was assumed to have been reached) would express approximately the total number of cubic feet as somewhat in excess of one billion, which roughly corresponds with the number of cubic feet embraced in an area of 30 odd square miles covered to the depth of one foot. This last, it will be recalled, was, in round figures, the area of the Lake at flood stage.

V.

Summary of Conclusions from Case Made by Complainant.

Summarising therefore, the conclusions from the facts thus reviewed may be stated as follows:

First: For draining the surface waters of a watershed within its limits comprising an area of approximately 750 square miles, Minnesota constructed and substituted for the natural discharge channel, an artificial channel of materially greater discharge capacity.

Second: This artificial channel tapped the lowest area of the watershed, where, under natural conditions, the surface waters necessarily accumulated.

Third: Within this low area the accumulated surface waters were mobilized and transported to the artificial drainage channel mentioned, by an extensive system of local ditching. The latter was made effective and functioned through the former. The whole artificial system must therefore, be viewed as a unit, in its ultimate objective and effect, as respects the watershed's drainage.

Fourth: The discharging capacity of the main artificial channel materially exceeded that of the natural discharge channel for which it was substituted and which, as conceded by the defendant's answer, it superceded. The

distance of flow was lessened. As a result, greater volumes of water were discharged into the ultimate outlet in lesser time than under natural conditions.

Fifth: The excess discharge as a result of these artificial conditions was estimated and the estimates checked and confirmed by the following methods.

(a) The available statistics of the run-off covering the general section of the country which embraces that in question, do not justify assuming a maximum run-off (cloud bursts or violent storms excepted) in excess of from .5 to .7 of an inch *per month* from the entire area of a watershed. This is the equivalent of from one-half to three-fourths of one cubic foot per second from each square mile of the watershed, or, assuming as in this case, an area of 750 square miles and taking the highest fraction above mentioned, the total would disclose approximately an average of 562 second feet *for the month.*

(b) The total maximum *annual* discharge for water courses in the same section is *two inches* from the entire watershed, indicating an average *throughout the year* of .15 of one cubic foot per second *per square mile* of watershed area. That is, the *average annual discharge* computed on the basis of cubic feet and apportioned to each square mile of the watershed is approximately one-fifth of the *maximum monthly average* above indicated. This discloses, for the entire area of a watershed of the size of that here in question (750 square miles) an average *for the year* of apporximately 102.50 cubic feet per second.

(c) The *actual readings* disclosing the *actual run-off* at Wheaton (the point of discharge for the watershed in question) covering the year from June, 1916 to June, 1917, *after the ditches were constructed,* showed an average for the year of 207 cubic feet per second or practically

double the average maximum *annual run-off* under natural conditions.

(d) The actual run-off during the year last mentioned (1916-'17) computed in inches from the entire surface of the watershed area was approximately 3.4 inches as against the maximum average under natural conditions of 2 inches, thus again showing the run-off slightly less than double following of the artificial conditions.

(e) While the comparitive computations based on yearly and monthly data may not be determinative of conditions, existing at times of spring floods or excess precipitation during relatively short periods, it is self-evident the ratio of run-off under the latter conditions, with the artificial construction tending to its acceleration, would be proportionately greater to that existing under natural conditions than the figures indicated by these averages. Hence, deductions from the criteria furnished by the longer period are, as applied to flood conditions, more favorable to the volume of natural run-off than the ordinarily attendant incidents of such flood conditions would justify. As presently shown, it is probable that under extreme flood conditions, the relative ratio of the run-off under the artificial conditions, would be nearer that of 2 to 1 of the natural run-off. For purposes, however, of immediate comparison, the general average, as indicated above, may be taken.

(f) Excluding then, computations based on the relative carrying capacities of the two discharge channels with which we have to deal (the cut-off and loop) and similarly excluding the increased ratio last above suggested, it is apparent that whatever amount be assumed for the volume of discharge at a given time, 50% of the total, upon application of the relative averages, is ascribable to the artificial construction, which is only another way of

stating, what is substantially confirmed by the data mentioned above, that the run-off under the artificial conditions is substantially doubled.

(g) The maximum *daily discharge* at Wheaton during the 1916 flood was, according to the estimate of Professor Bass, 2200 second feet. This, it should be recalled, was based on readings of the *actual discharge* during 1916-1917, after the artificial construction was operative and projecting the results thus obtained to what this witness assumed to have been the maximum flood level during the 1916 flood. Hence, for present purposes, the estimate presupposes the presence and operative effect of the artificial construction. Upon application of the averages, the natural run-off for the assumed *maximum flood day* would have been 1100 second feet. In other words, this concedes for the maximum flood day's discharge (1100 second feet) under natural conditions, practically double the highest monthly average estimated for a month of excessive precipitation (562 second feet) as shown in sub-division (a) *supra*. Even on these assumptions, *the excess due to the artificial drainage* is, in round figures, 1100 second feet.

The maximum flood day discharge in 1916 at Wheaton as determined by Dean Shenehon and Professor Chandler similarly based on projecting the readings of 1916-1917 to *the actual flood level* during the 1916 flood was 3500 second feet. Applying the same average, the proportion of this total under natural conditions would be 1750 second feet. This amount however, *exceeded the maximum carrying capacity of the natural discharge channel*, (1200 second feet as computed by Professor Chandler and 1500 second feet as computed by Professor Bass.) The proportionate discharge thus assumed for the natural conditions is thus seen to have been a physical impossibility

The result thus indicated confirms broadly what was stated above, that the employment of the assumed average is unduly favorable to the discharge under natural conditions, as applied to maximum flood stages. The assumption above indicated of the ratio of 2 to 1 under extreme flood conditions will be found to work out more consistently.

Incidentally, the matters referred to in this sub-division disclose that the relative carrying capacities of the respective discharge channels cannot be ignored if anything approximating correct results are to be obtained.

(i) Applying this ratio to the maximum discharge of 2200 feet as estimated by Professor Bass for 1916 and the relative contributions would be 750 second feet, in round figures, attributable to the run-off under natural conditions and 1450 second feet attributable to the artificial construction. This result, it will be observed, approximates more closely the highest average estimated on the basis of one month (562 second feet) as shown above.

While a greater discrepancy might reasonably be looked for, between the maximum flood day and the average extended over the entire month and while the monthly estimate is based on the assumed highest monthly run-off for a month of excessive precipitation, the maximum day assumed in this sub-division is reached, as already stated by assuming flood levels materially lower than those actually disclosed by the facts. These considerations reconcile, to some extent, the discrepancy above suggested and the relative approximation of the average monthly maximum to that of the maximum flood day. This latter feature apart however, the confirmatory character of the results are apparent.

(j) The maximum flood day discharge in 1916 as determined by Dean Shenehon and Professor Chandler from

the actual flood levels was 3500 second feet, as above stated. Applying the same ratio to this total, the relative proportion, ascribable to the natural conditions, would be, in round figures, 1300 second feet and the excess over this amount attributable to the ditching, 2200 second feet. This, it will be observed, again presents the case of the *maximum day* under natural conditions at extreme flood stages (1300 second feet) as against the ***highest daily average*** extended over the month (562 second feet) and thus more nearly conforms to the difference that would reasonably be looked for, as already suggested.

(k) The maximum discharge capacity of the cut-off at flood stage was computed by Mr. Ralph at 2400 second feet and by Professor Chandler at approximately 2000 second feet. The maximum carrying capacity of the natural channel (the loop) was computed by Professor Bass at 1500 second feet and by Professor Chandler at from 1000 to 1200 second feet. Assuming, at extreme flood stage, both were discharging to maximum capacity and accepting the highest value for the loop as indicated by the above figures and the relative contributions to the discharge would be 1500 second feet for the loop and 2000 second feet for the cut-off. This result, it will be observed, substantially confirms the ratio assumed in the above computation which disclosed 1300 second feet for the loop and 2200 second feet for the cut-off. The substantial accuracy of these computations is seemingly, therefore, incontestable and their results confirm the excess discharge from the artificial construction as claimed by complainant.

(l) Lacking absolute readings of the discharge at Wheaton during the floods of 1915 and 1916, it is impossible to postulate the precise number of days during which the waters were rising to the maximum flood stage (the

level at which the maximum of 3500 second feet discharge was computed) and the number of days during which they were receding. Professor Chandler assumed for this purpose the period of ten days with an average during that period, of 2500 second feet discharge. From the circumstance the correctness of this assumption was not questioned by the defendant, or, if questioned, that no attempt was made to establish the relative time in which flood waters reach their crest and recede, as determined by actual experience, we assume the substantial accuracy of Professor Chandler's figures.

Employing the same ratio as above for determining the relative contributions for the mesne discharge of 2500 second feet over the ten day period, discloses an average of 900 second feet for the loop (that is, the natural discharge) and 1600 second feet for the cut-off (that is, the excess due to the artificial drainage.) The conclusion thus reached of the maximum flood day's discharge (900 second feet) as compared with the daily average extended through the month (562 second feet) is thus seen to be entirely consistent with what would ordinarily be assumed for such conditions.

(m) It has already been sufficiently demonstrated that an excess discharge of 1000 second feet for ten days was sufficient to raise the level of Lake Traverse (at its assumed flood area of 30 odd square miles) one foot and account for the flooding of the Bois de Sioux Valley.

In the foregoing, the existence of this excess has been confirmed by a variety of computations for the purpose of demonstrating that the result may be postulated on a relatively wide range of assumed conditions. While certain of these computations proceed from generalizing, the comparitive results have served for purposes of illustration.

Approximate accuracy, however, is predicable of those computations in which the relative carrying capacities of the two discharge channels and their respective contributions to the ultimate volume of discharge are presented. The results of these last disclose that the estimates of both Dean Shenehon and Professor Chandler, erred, if at all, on the side of conservatism and that the estimate of Mr. Ralph that the lake level was raised, as a result of the excess discharge from the artificial drainage, from one to two feet, is more nearly correct.

Sixth: That the flooding of the Bois de Sioux Valley was therefore ascribable to the drainage by Minnesota of naturally accumulating surface waters within its limits into the natural (interstate)discharging channels with the result of over-taxing and surcharing the capacity of those channels.

VI.

The Defendant's Case.

For convenience in this review, the case as made by the defendant may be considered under two main heads, viz: (a) the non-scientific and (b) the scientific.

The Non-Scientific Features of Defendant's Case.

1. A large number of witnesses were called to attest the fact the delta zone, so-termed, had no existence. The results of this testimony, so far as the issues are concerned, are negligible and relatively brief consideration thereof is therefore, necessary. The main objective in this feature of the case appears to have been to permit counsel for the defendant to indulge in extravagant and unwarranted assumptions of the claim of complainant with re-

spect to this area, and address his proof to their denial. From the standpoint of defendant's counsel, this process may have proven satisfying, but it has served to inject in the present record, a mass of cumulative matter largely devoid of material significance.

As heretofore shown, there was, in reality, no issue on this feature of the case. The contention of the complainant, as already shown, was that the area included in this delta zone was a natural flood plain. That in times of excessive precipitation, such as ordinarily occur in spring break-ups and at other seasons of abnormal storms, this area was subject, to a greater or less extent, to overflow. The conditions in this regard were intensified by the lack of natural drainage.

Every witness called by the defendant attested the existence of these conditions, in part at least, depending largely on his own observations.

It was attempted to be shown that within this area, or in part within and in part without the same, some 130 odd farms existed which had been cultivated for many years. There was no dispute with respect to this feature of the case. It was not claimed that a portion of this area had not been settled upon and cultivated. The fact itself had no material bearing on the existence of the natural flood plain, except at it might have disclosed, but did not, that the settled portion of the area was not subject to inundation in flood periods.

The testimony of the following witnesses called by defendant is typical, as will be disclosed by brief reference to the record.

William Ringdahl claimed to have been more or less familiar with the general area included in the delta zone since 1893. (Rec. 556.) Prior to 1896 there were about 128 settlers there. Rec. 562. The number had not been materially increased since that time. Rec. 641.

In the winter of 1897 there was a heavy fall of snow. In the spring the water spread all over the country. Rec. 636 (993), 637.

All this land needs ditching to take off the excess water. Rec. 637 (997), 638.

After the first section of the ditch (the original ditch) was constructed in 1897, the lands in the delta zone were more flooded than they had even been before to my knowledge. Rec. 652 (1019.)

Was one of the committee that appeared before the legislature on behalf of local residents and recalled the appointment of the committee to investigate water conditions in our county. Rec. 653 (1020-1021.)

Edward Rustad had resided at Wheaton since 1889. Was a lawyer and bank president. Had been a member of the Minnesota state senate for seven years. Rec. 1036.

Knew about the construction of the original state ditch and about the farmers in that section petitioning the legislature for relief from flood conditions in the delta zone and other parts of Traverse County. Rec. 1059.

Was to some extent instrumental in presenting this petition on behalf of his constituents and by reason of his interest as a resident of the county, in securing the relief. The farmers in this district needed the relief and the witness used his best efforts to secure the passage of Chapter 138 of the Laws of 1911. Rec. 1060.

Emanuel Hawkinson, a farmer didn't know as any of the lands in the delta zone were very swampy. The land east of Redpath Slough was lower than that south and north and seemed somewhat like sloughs extending into Grant County. Rec. 701.

Didn't think any of the lands in the delta zone were overflowed, but wasn't around in flood times except in the vicinity of the slough and along the creeks. Rec. *id.*

The lands in the delta zone are similar to the rest of the lands of Traverse County except that in flood seasons part of them would be flooded. Rec. 703 (1105.)

Had seen Five Mile Creek before the construction of the original ditch overflow a large area of the delta zone in summer when there had been a lot of rain. Rec. 707 (1112.)

The land betwen Five Mile Creek and Twelve Mile

Creek is very good. In very high water it was probably flooded. Rec. 708 (1113.)

In spring time the flood waters came into the zone partly from the two creeks from the south and partly from the Mustinka from the east. Rec. 713 (1121), 714 (1123.)

Had seen water standing around Norcross to the east in the spring. In the flood of 1881 his lands were flooded and he presumed the same conditions existed over the delta zone. Rec. 714 (1124), 715 (*id.*)

The whole system of ditches put in through the delta zone was necessary and proper and benefitted the land. In certain years the land needed the drainings and in others, not. Rec. 717 (1129), 718 (*id.*)

Saw the flood conditions in delta zone in 1897 and subsequent years.

Julius H. Tesky,—farmer—came to Traverse County in 1892. In 1909 moved on to a farm in the delta zone. Rec. 725.

After buying this land, had trouble with water both in the spring and summer. Rec. 739 (1163.)

Have seen flood waters covering part of our land and others to the north, south, east and west. Rec. *id.*

In the spring of 1916 saw the conditions of the high water. The whole country was flooded all over this delta zone. Rec. 746 (1176.)

Thomas Heggan,—farmer—had resided in the delta zone since 1889. His lands were located in the area southwest of the outlet of the cut-off. Rec. 749.

There had been times before the ditch was constructed when this area was overflowed and the water spread over the area to a width of two miles. Rec. 750 (1182.)

The first time I saw the overflow was in 1897. The water was about a foot and a half higher than in the spring of 1916. Rec. 750 (1183), 751.

The only other year he saw this section flooded was 1916. The lands above were flooded pretty nearly every year. Rec. *id.*

The construction of the ditch had been a damage to his land. Rec. 752 (1186.)

Following the spring flood of 1916 they had a later flood in the summer of that year. They had unusual flood again in 1917. Rec. 754 (1189.)

There were no unsual conditions in 1917 and there was no unusual amount of snow in the winter of 1916-17, yet they had had practically as much of a flood as in 1916. He couldn't account for it. The flood of 1917 could not be blamed to excessive rains. Rec. 756 (1192.)

Carl Krenz,—a farmer, had lived in the delta zone since 1898. Rec. 957.

Both the Mustinka and Five Mile Creek overflowed when they had wet conditions. Rec. 976 (1194.)

Whenever the waters reached a stage where they flowed over into the Tintah Slough, the upper Mustinka east of Twelve Mile Creek was out of its banks. Also, the waters of Five Mile Creek. The country east of Twelve Mile Creek was covered with water. Rec. 981 (1502).

This water came from the country east and south. Rec. *id.*

Remembered the floods around Norcross in the early days. The first section of the ditch was put in to drain the territory up there. Rec. 982 (1504.)

The lands needed drainage. This was true of all the lands in Rednath and Clifton Townships and the ditches were put in to drain them. Rec. 983 (1506.)

It is unnecessary to pursue this review further. The testimony of the other residents of the area in question was substantially the same. This, far from controverting, confirms the contention of the complainant with respect to the general character of the area in question, as one subject to flood conditions and requiring artificial drainage.

Notwithstanding the number of witnesses called and the mass of detail elicited from them, it will be noted there is no claim the entire area within the delta zone is settled or cultivated even up to the present time. The emphasis laid on the number of farms existent in this area is misleading. If it be assumed the number were to be increased to 150 averaging a quarter of a section each, the aggregate area would only slightly exceed 24,000 acres, or considerably less than half of the area of

the delta zone, on the assumption that zone should be considered as embracing substantially 75 square miles.

The evidence of the defendant with respect to the physical features of the delta zone was immaterial and has accomplished nothing beyond injecting a moot issue in the case.

2. A large amount of time was devoted in the examination of these witnesses to eliciting the action or flow of the flood waters under natural conditions as compared with those existing following the construction of the ditches. This testimony may be summarized as directed at showing substantially the following features.

(1) When the flood waters at the confluence reached a certain stage, their flow was north into the Tintah Slough and the Rabbit River.

(2) The construction of the ditches had not resulted in any material change in respect to such overflow to the north.

(3) The floods of 1915 and 1916 following the construction of the ditches were as great or greater than any that had been previously known. That the ditches had not therefore, served to improve the flood conditions.

(4) The natural channel of the river would open in the spring earlier than the ditches and the greater part of the spring flood waters would, therefore, be accomodated by and flow off through the former.

(5) The natural channels appeared to carry as much water since the construction of the ditches as they did previously.

(6) The effect of the ditches was mainly observable during the periods of summer floods when they served to drain the waters faster.

(7) The ditches ceased to be effective when the floods overtaxed their capacity, i. e. when the entire surround-

ing area was submerged. At such times they appeared to cease functioning.

The observations of the different witnesses varied in detail and were not entirely in accord but the features above enumerated will suffice to indicate what was sought to be elicited and what, it will doubtless be claimed, may be deduced from their testimony as a whole.

The most cursory consideration will disclose these contentions present nothing of material importance.

It was testified by Mr. Ringdahl that approximately $1,000,000. had been expended in the construction of the elaborate system of local and county ditches in the section in question. Rec. 623 (970.)

The correctness of the principles employed in this construction, from an engineering standpoint, is attested by the experts of complainant and substantially admitted by the expert of the defendant. The entire system, as thus constructed, was made effective by the new and enlarged channel provided by the state ditch, as the substitute for the inadequate natural channel of the Mustinka River.

Under these conditions, non-expert contentions and observations, with respect to the effectiveness of the system, is presumably ascribable to the natural tendency of never being satisfied, regardless of how much may be done toward relieving a difficult situation.

If the conditions were as bad as attested by certain of the witnesses referred to, notwithstanding all that had been done for the relief of the general area involved, it only serves to emphasize that the claim of complainant, with respect to the previous condition, has been under, rather than over-stated.

It is probably true and the observations of these witnesses confirm the conclusion, that the construction of the artificial drainage system tended to concentrate the

run-off, at the general area of the confluence, in greater volume than had existed under natural conditions. This would be a natural and necessary consequence of the artificial discharging channels drawing the water more rapidly from the entire area of the flood plain and concentrating its flow to the confluence in shorter time. The result in this respect was inevitable and is largely contributed to by the circumstance that the outlet through the cut-off and rectified Mustinka River is still inadequate to discharge this accumulation of the waters at the confluence. The probative force [illegible] features, in so far as they are possessed of probative force, is diametrically opposite from what was intended and confirms the contentions of complainant, for it will be at once observed that if the capacity of the state ditch were increased sufficiently to relieve the difficulties attested by these witnesses, the results would be the still greater impairment of the delta zone as a detaining basin and discharging a still greater volume of water into Lake Traverse, with the increasing tendency to floods in the Bois de Sioux Valley.

While therefore, the artificial construction in Minnesota has already doubled the discharge into Lake Traverse, to afford the relief which the residents of this area indicate as necessary, a still further impairment if not total destruction of the detaining basin would be required. In other words, the system should be made more effective for casting the burden on to "the fellow further down stream."

Other features of this testimony such as that involved in the assumptions with respect to the carrying capacity of the ditches in the spring and their loss of functioning power when submerged, may be more profitably consider-

ed in connection with the later discussion of the expert testimony.

3. The record is cumbered with wholly unnecssary detail in the testimony of the witness Ringdahl, *supra,* with respect to measurements of the cut-off and rectified channel. Rec. 605 *et seq.*

According to this witness, the cut-off was 13,000 feet in length. Its bottom elevation at the upper end was 995 and at the lower point of junction with the river, 988. Rec. 605 (941), 606 (*id.*)

The top width varied from 38.2 feet to 46.8 feet and the depth from 7.4 feet to 11.4 feet. Rec. 602 (937), 603 (938.)

Continuing down stream toward the outlet, the width of the cut three feet from the bottom was 40 feet and the cut itself 3.5 feet deeper than the original channel. Rec. 606 (942.)

At station 490, substantially midway between the cut-off and outlet, the cut was 5.9 feet below the depth of the original channel. Rec. 609 (946.)

At stations 796 to 798 the cut was from 15 to 16 feet and 8 inches deeper than the original channel. Rec. 619 (951.)

The elevation at the bottom of the ditch at the outlet was 971.2. Rec. *id.* Thus disclosing a fall of 17.2 feet from the upper end of the rectified channel.

Considerable emphasis has been laid on the discrepancy between certain of the dimensions testified to by this witness and those given by Mr. Ralph. The latter's testimony was in substance that the cut-off had a bottom width of 30 feet; a side slope of one to one; a top width varying from 50 to 60 feet for the first two miles and from that point to its outlet, a bottom width of 40 feet. Rec. 313, f. 463.

The measurements made from actual surveys, Rec. 314, (464 *et seq.*) and shown in the cross sectional areas on complainant's Exhibit 5 (Rec. 2154) which last were rechecked and confirmed in complainant's Exhibit 49 (Rec. 2158) remove any serious question with respect to these claimed discrepancies

The differences, such as they were, were readily solved by reference to actual surveys made in preparation for the trial of this case and but for the apparent purpose of the defendant to confuse the issue by injecting a mass of complicated and unnecessary data, no possibility of dispute would have arisen with respect to these features.

That these assumed discrepancies have no material bearing on the actual controverted features of the case, will sufficiently appear in the next following sub-division of this brief.

(b) The Scientific Feature of Defendant's Case.

Discussion under this head addresses itself almost exclusively to a variety of deductions and computations by defendant's expert, Professor Frederick H. Bass, to whose experience and qualifications reference was made at an earlier point in this brief.

As a background for this testimony, a large amount of detailed data was prepared and embodied in a series of illustrative charts etc., appearing as exhibits in the present record. For the most part this data was purely cumulative and subserved no other function than that of confirming features of the case with reference to which there was and could be no substantial controversy. Extended reference to it, therefore would serve no other purpose than that of re-traversing ground already covered

regarding features of which there is little or no dispute.

The controversy arises with respect to the conclusions deduced from this data. The present discussion will, therefore, address itself to those features of Professor Bass' testimony, with specific allusions to the particular instances in which the data employed is questioned by complainant.

For its bearing on what follows, allusion may be made at this point to the fact that Professor Bass disclaimed any knowledge or familiarity with the general area involved in this case, previously to the year 1917, after the floods in question. His investigations on the ground were confined to approximately one week. His deductions were dependent in many instances on assumed or purely theoretical data. In fact, it might be broadly stated at the outset, that the entire scientific case, as expounded by him and relied on by the defendant, is based on theory and wholly lacking in those practical phases which ordinarily give theory its weight and value.

As not infrequently happens under such conditions, a number of the most important deductions of Professor Bass, essential to support his general theory, are demonstrated to have been erroneous in principle, or, to have proceeded from the employment of factors having no basis in the facts.

As will be presently shown, he, himself, admitted in substance that the demonstration of these errors would disprove his entire theory and lead to diametrically opposite conclusions.

1. The Theory of Proffessor Bass.

As the defendant will doubtless expound this feature of the case, we may content ourselves with reviewing its substantive features, as follows:

Based on the survey of Mr. Nelson, the approximate area of the watershed tributary to Lake Traverse and the Bois de Sioux River in the three states was 1400 square miles. Of this total, 793 square miles was included in the Mustinka watershed. From this, the drainage area (67 square miles) of Eighteen Mile Creek, should be deducted, as having no material bearing on the case.

The Mustinka watershed should be considered as embracing four separate drainage areas of the respective dimensions expressed in square miles as follows:

1.	Upper Mustinka,	203
2.	Five Mile Creek,	121
3.	Twelve " "	364
4.	Below the cut-off,	38

At extreme low water, (971.68) the area of Lake Traverse was approximately 20.6 square miles; at the normal stage (973.3) 27.4 miles and at flood stage, (976.6) 38 miles.

This estimated area included the entire water area up to the White Rock road.

Assuming the flood stage in the Lake in 1916 at 977, the slope from its outlet north to White Rock was approximately one foot; in the next 9 miles, 2.6 feet and from that point to the South line of Sec. 15-130-47, 4.4 feet, a total fall of 8 feet in about 11 miles, thus giving an elevation at the point last indicated at flood stage of 969. With this latter assumed elevation and a velocity

of 2.7 second feet, the discharge of the Bois de Sioux was 2000 second feet.

The objective feature of this computation was for its bearing on the volume of water required to be contributed by the Mustinka watershed to raise the level of Lake Traverse sufficiently to explain the floods.

In the Bois de Sioux Valley commencing with what was termed the White Rock road, just north of the town of that name, a series of roads crossed the Valley east and west with surface elevations varying from zero to a few feet. These roads, in flood periods, tended to aggravate the flood conditions, diminishing the hydraulic gradiant more than if the same obstructions were placed on a steep slope and similarly diminishing the flow. The same was true, to some extent, of the railroad embankments constructed in the same area.

Taking up the topographical features in the Mustinka watershed, the character of the upper Mustinka (moraine zone) was such as tended to reduce rather than increase run-off.

The slope of Five Mile Creek for twelve miles south of the confluence was 3.11/12 feet with the slope of the land in the same area about 5 feet to the mile. The slope of Twelve Mile Creek, for approximately fourteen miles below the confluence, was 5.6 feet with the general slope of the land between 4 and 5 feet to the mile.

These factors, including the greater mileage of the drainage area tributary to Twelve Mile Creek, were evidently thought to confirm and emphasize the later contention that that Creek was the dominant stream at the confluence. This last for its bearing on the contention, respecting the volume of discharge into Lake Traverse and the respective contributions to that discharge, by the natural and artificial channels.

Coming to the ditch construction, the slope of the original ditch was 4.75 feet to the mile and that of the rectified channel from the mouth of the cut-off to the outlet in Lake Traverse, 1.32 feet to the mile.

With respect to the cut-off, the following complicated factors were introduced. For the first 1800 feet, the gradient of the bottom was negative. Then follows the

Fall per mile in first	3800 feet	.2 feet.
" " " " next	1100 "	.3 "
" " " " "	1200 "	.6 "
" " " " "	1300 "	.1 "
" " " " "	3350 "	2.0 "
" " " " "	550 "	.3 "
" " " " "	7500 "	5.8 "
Total	18700	9.3

The average slope for the entire length of the cut-off was therefore stated to be about 2.1 feet to the mile.

It should be noted at this point for its bearing on what follows, that these latter figures take no cognizance of the *natural slope of the ground;* that the aggregate length of the cut-off in the tabulated statement is 18,700 feet, whereas, its actual length, as shown on the map and disclosed by the detailed figures of Mr. Ringdahl, was 13,200 feet; that the average slope, correctly computed on the tabulated figures, would be 2.62 feet to the mile and that the average slope based on the corrected length of the cut-off and assuming the correctness of the other figures shown, would be 3.72 feet to the mile.

These figures were detailed as a basis for computing the relative carrying capacity of the cut-off, as compared with that of the natural channel round the loop.

For the purposes of these computations, certain cross

sectional areas of the natural channel were taken, with *an assumed level* for the waters at flood stage and a velocity of 1.66 second feet, resulting in determining the discharge capacity at the point of greater sectional area as 1825 second feet, and at the point of lesser sectional area as 1340 second feet. These figures were approximately averaged, for the purpose of determining the capacity of the natural channel, at 1500 second feet.

Taking a similarly *assumed level* for the waters at flood stage in the cut-off (a depth of 10.7 feet); the slope as shown by the bottom elevations above enumerated and the velocity of 2.4 feet, the maximum discharge of capacity in the cut-off was determined at 1000 second feet.

Based on the readings of the actual discharge, shown at the government station near Wheaton, covering the period from June, 1916 to June, 1917, and projecting those readings to an *assumed flood level* reached by the waters in 1916 at that point, it was estimated there were 4 days during the 1916 flood in which the discharge at the outlet exceeded the maximum discharge capacity of the natural channel around the loop, viz., March 30, 1597 second feet; March 31st, 1820 second feet; April 1st, 2230 second feet; and April 2nd, 1962 second feet. This excess over the discharge capacity of the natural channel would account for a rise in the level of Lake Traverse during the flood period of possibly two inches.

The theory thus expounded was substantially this: That it would be assumed the volume of waters, up to the maximum carrying capacity of the natural channel, would have reached the outlet in any event, wholly regardless of the ditch construction, and that the latter's contribution to the ultimate volume of discharge should therefore be measured by the excess.

That the ultimate reasoning thus resorted to presents a fallacy from an engineering standpoint and that so many of the assumed factors entering into the calculations were contrary to existing facts, as to destroy any possible force for the theory itself, will be presently shown.

The entire theory of defendant's case will be seen to revolve around the general proposition last stated, to the effect that the contribution of the ditch construction to the discharge from the Mustinka watershed was negligible. Incidentally, emphasis was laid on the following features:

(a) That the records disclose the waters of Lake Traverse had reached substantially as high a level in 1881 as they did at the crest of the flood in 1916.

(b) That Twelve Mile Creek was the dominant stream. That it was cut at substantially right angles by the original ditch and the cut-off. This tended to minimize the flow of the cut-off and to produce a back-water effect in the original ditch. The flood waters of Twelve Mile Creek would thus sweep to the north in substantially unimpaired volume and pass through the natural channel round the loop. The resultant discharge in Lake Traverse to the extent of the loops carrying capacity would be assigned to it and the excess, if any, to the cut-off, as already stated.

(c) In times of spring flood the action of the sun would tend to clear the natural channel earlier than the ditches, hence, at flood stages, it might be concluded the peak would pass through the natural channel before the ditches would function.

(d) The conditions of precipitation during the years 1914 to 1916 inclusive, sufficiently accounted for the floods without ascribing any materially responsible effect to the artificial drainage.

(e) The ditches in the delta zone, including the state ditch, did not appreciably lessen the time of the discharge of the flood waters into Lake Traverse. This, for the reason that in times of flood the capacity of the ditches was exceeded, resulting in their inundation. When inundated the ditches would cease to function.

(f) For the same reasons the ditches would not materially increase the run-off of the area involved.

(g) Assuming the excess of precipitation, during the winter of 1916-1917, over nomal of approximately 25%, such excess might account for 50% of the *excess discharge* over the natural discharge of the loop, at the outlet in Lake Traverse.

(h) 1915 and 1916 were flood years throughout the whole Red River Valley and the flood conditions in the Bois de Sioux Valley were not dissimilar from those experienced in other localities.

2. Analysis and Refutation of the Bass Theory.

Only the most cursory examination is required to demonstrate that many of the incidental features of the foregoing contentions are of no material importance to the case, or, as the idea was expressed in substance by Dean Shenehon on rebuttal, that Professor Bass "was grasping at straws."

(a) The assertion that the roads in the Bois de Sioux Valley were material contributing factors to the flood conditions is absurd. There was no claim these roads were of recent origin or construction and had they played any substantial part in flooding the valley, the same resultant effects must have manifested themselves in previous years, as at the time of the floods in question. In other

words, there is no reason or basis for assuming these roads were productive of different results in 1915 and 1916 from those produced in previous years when no such flood conditions had existed.

They may be regarded therefore, for the purposes of this case, as a natural condition. They were entirely submerged during the flood period and constituted therefore, nothing more than an irregularity or obstruction on the bottom surface of the flooded area. Their effect on the floods was purely academic.

See Shenehon, Rec., 2066 (3393).

(b) If it be assumed the waters of Lake Traverse reached as high a level in 1881, as they reached at the flood stage in 1916, it would demonstrate nothing more than a condition of excessive precipitation and run-off under natural conditions in the earlier year. Had the run-off of the earlier year *been increased and accerelated by the artificial conditions* existing in 1916, the floods at the former period would have been correspondingly increased.

Moreover, no correct deductions can be made from comparing a situation under previously existing natural conditions, with one existing under the artificial conditions, except where the other factors are the same. Those factors are lacking so far as the year 1881 is concerned and the comparison therefore, proves nothing.

See Shenehon Rec., 2066 (*id.*) 2067 (*id.*)

(c) The computation of the discharge of the Bois de Sioux River at flood stage as 2000 second feet is of relatively little importance. It illustrates however, the methods pursued by Professor Bass in most of his computations, which were based on assumed data, the assumptions in each instance being those which would contribute to the desired result. To obtain the discharge indicated, a cross-sectional area was required, assuming an eleva-

tion of the flood waters of 979, whereas the actual elevation was 1½ feet lower, (977.5). With the correction thus indicated and accepting the other computations of Professor Bass, the discharge should have been 1400 second feet.

See Shenehon, Rec., 2067 (3394).

See Chandler, Rec., 2096 (3446).

d) The contention that Twelve Mile Creek was the dominant stream; that the intersection of its channel by the ditch at substantially right angles tended to minimize the flow to the west and to produce a damming effect in the original ditch to the east, involves nothing more than a visionary conception opposed to accepted principles of practical engineering.

See Shenehon, Rec., 2070 (3400-3401).

Moreover, it is not borne out by the facts as the angle of intersection between the ditch and the cut-off was obtuse. This is clearly shown by complainant's Exhibit 49 (Rec. 2158).

(a) The results assumed from the action of the sun in opening, as claimed, the natural channels before the cut-off at times of spring flood, evidently proceeds from the assumption that the sun in this latitude has a course from north to south instead of from east to west.

See Shenehon, Rec., 2069 (3397, 3398).

See Chandler, Rec., 2098 (3449, 3450).

The defendant has apparently overlooked that its contentions in this regard would apply, in part at least, to the rectified channel as well as the cut-off. As the latter, for reasons presently to be considered, was a controlling factor in discharge capacity of both the cut-off and loop, the deductions from this contention may be disregarded as devoid of significance.

(f) The general assumptions that the flood conditions in question were sufficiently accounted for by the natural causes of precipitation and run off, without reference to the artificial conditions, merely begs the question. The defendant seems unable to comprehend the feature so clearly expounded in Dean Shenehon's testimony that *whatever may be assumed for natural conditions, those of artificial creation have superimposed upon the former features necessarily increasing the resultant flood conditions.*

Whether flood conditions in the area in question would have existed under natural conditions in the years 1915 and 1916, is a matter of pure speculation so far as this case is concerned. It may be assumed they would have so existed. The question in this case is whether they would have been *similar in extent and duration.* The best available criteria in this respect is comparison with previous periods when the conditions were nearly identical and no such condition of flooding existed.

(g) The whole contention that the system of ditch construction in the delta zone, including the state ditch, made no perceptible impress on the flood conditions at the confluence is so far opposed to natural laws and common sense as to require no argument. The explanation of this result, on the assumption of the complete inundation of the ditch system, with the consequent cessation of their functioning, only serves to illustrate the extremes to which the defendant was willing to go in constructing its theories in this case.

See Shenehon, Rec., 2072 (3403).

See Chandler, Rec., 2099 (3451).

See Ralph, Rec., 2112 (3475).

The contentions of the defendant in this respect pre

sent an amusing aspect, in view of their necessary assumptions with respect to the inundation of the delta zone. The depth of the waters in this inundated area which would raise their level at the confluence to the level of the ground surface eight or ten miles to the south, needs only be conjectured and contrasted with the vehement assertions of defendant, that inundation of this area was practically unknown.

(h) The contention with respect to the increase in run-off resulting from the increased percentage of precipitation during the years 1915 and 1916, with the assumption this accounted for one-half of the excess volume of flow at the outlet in Lake Traverse over defendant's assumed maximum discharging capacity of the natural channel round in the loop, is purely fanciful and involved Professor Bass in inextricable confusion. The results in this regard were quite obviously due to the Professor's obsession with respect to differentiating between the discharge of the natural channel and the maximum at the outlet, the difference being termed the excess and ascribed to the artificial conditions. On direct examination, in the attempted explanation of his theories, the conclusion was reached that 25% increase in precipitation would account for one-half of the excess flow at the outlet, that is, one-half of 50 second feet. Rec., 807 (1260).

Observing the absurdity, the witness sought to qualify the results on cross examination, by increasing the amount due to the increased percentage of precipitation to 200 second feet and ascribing the effect to the entire volume of discharge, instead of the excess portion over natural channel capacity. Rec., 844 (1311).

The theory thus advanced is so utterly inconsistent with the other extravagant claims made by the witness, for the

results reasonably to be expected from a 25% increase over normal in precipitation, as to deprive the entire matter of significance and again disclose the absurd limits to which the witness was willing to go in attempting to bolster up his academic views.

It is perfectly obvious that a given percentage of increase above normal in precipitation over the area of an entire watershed would be reflected in the entire run-off and not in some particular part of that run-off.

As the volume of run-off expressed in inches over a given area or expressed in second feet of discharge is relatively small compared with the total volume of precipitation, it is apparent that an assumed increase above normal of 25% in the latter would increase the former in corresponding greater ratio, so that the assumed increase of precipitation might, and under such conditions as prevailed in the area in question would, increase the run-off several hundred per cent.

See Chandler, Rec., 2098 (3450).

(i) This reduces the contentions to those based on the comparative discharging capacities of the natural channel as compared with that of the cut-off and the assertion that the volume of ultimate discharge in Lake Traverse should be held increased, by the ditch construction, only in the amount in which the total volume of discharge exceeded the natural carrying capacity of the loop.

The factors entering into this theory include (1) the computations and (2) the deductions therefrom.

1. In computing the respective carrying capacities of the loop and cut-off, Professor Bass again had recourse to assumptions. The water level, for the purpose of determining the cross sectional area, was taken at 1002. In other words, 2½ feet below the flood level stage as ascer-

tained from actual elevations.

See Ralph, Rec., 2109 (3470) 2110 (3472).

The objective purpose of lessening the cross sectional area and therefore of the carrying capacity of the cut-off is obvious.

The velocity for the natural channel was taken at 1 feet while that of the cut-off was taken at 2.4 feet. The relatively low valuation for the velocity of the cut-off was obviously determined for the similar purpose of decreasing its discharge capacity.

Having regard to the fact these streams had the same water levels at their common points of inlet and outlet and consequently the same fall, the fact that one was approximately 1/3 the length of the other would demonstrate a correspondingly increased velocity for the shorter distance. That the correct velocity should have been taken at a minimum of 4.5 feet in the cut-off and probably materially exceeded that is clear, as shown by the other testimony.

See Shenehon, Rec., 2067 (3395) 2067 (3396).

See Chandler, Rec., 2096 (3446-3447).

See Ralph, Rec., 2110 (3471, 3472).

The results, accepting the other factors employed by Professor Bass, would be at least double his estimate and perhaps more. Taking the actual water levels at 1004½, as observed by Mr. Ralph at the peak of the flood in 1916 and confirmed by levels subsequently run, the cross sectional area of the cut-off showed approximately 500 feet as against 400 in Professor Bass' computations.

See Ralph, Rec., 2110, *id.*

Complainant's Exhibit 49, Rec. 2158.

The resulting maximum discharge capacity of the cut-

off is, therefore shown in round figures at 2400 second feet. Rec., *id.*

In the light of the matters thus referred to, reference may be had to the following portion of Professor Bass' cross examination.

> "Q. If your theory of the diversion of waters through the 12 Mile Creek and the practical damming of the cut-off ditch thereby is erroneous, and if the cut-off ditch channel carries instead of 1000 ft. in the vicinity of 2500 ft., your theory falls, doesn't it?
>
> A. If the cut-off channel carried 2500 sec. ft. for a short length of time it does not. If it carried 2500 ft. long enough, my theory in regard to the rise of Lake Traverse, attributable to the construction of this ditch necessarily falls.
>
> Q. And if your theory in regard to the amount of water carried by the cut-off ditch in the amount which I have last stated of 2500 sec. ft., or thereabouts, continued for ten days, you could not justify the figures you have given us with respect to the effect on the elevation of Lake Traverse, could you?
>
> A. No, sir.
>
> Q. And the result would be under the circumstances that I have last stated that we have waters carried into Lake Traverse very materially adding to its elevation, that wouldn't have come in in a state of nature, that is true?
>
> A. If they came in at that rate.
>
> Q. If they came in at that rate or thereabouts?
>
> A. That is true. Rec. 843 (1309-1310.)

Professor Bass' computations with respect to the volume of discharge, at the outlet near Wheaton, during the 1916 flood are similarly inaccurate. Here, again, we find assumptions for the flood levels several feet below those actually attested.

The observations in this respect of Mr. Powrie, Engineer of the Chicago, Milwaukee & St. Paul Rail-

way confirms those of other witnesses in this respect. The level thus attested is projected in complainant's Exhibit 49 with the cross sectional area of the river at that point disclosing a maximum discharge of about 4400 feet. Allowing for some decrease by reason of diminished channel capacity between this point and the outlet, a maximum of 4000 second feet is probably as nearly accurate as could be obtained. This is a complete refutation of the claim by Professor Bass such maximum should be computed at 2300 second feet and shows that the discharge computed by Dean Shenehon and Professor Chandler is conservative.

2. The deduction from the various erroneous factors thus indicated has already been noted in substance as follows: Having determined the maximum discharge in Lake Traverse, it should be assumed the loop contributed to this maximum to the extent of its carrying capacity and only the excess over this latter figure should be attributed to the cut-off. The fallacy of this is so patent that even the witness himself resorts to evasion, by explaining his contention as not intended to indicate the results, thus arrived at, should be treated as the respective contributions *at a particular time* but that as the maximum amount which could be carried by the loop would be discharged *at some time* in a state of nature, it is fair to assume that the drainage system is only accountable for the excess.

The qualification destroys even the element of plausibility, eliminating as it necessarily does, the all-important factor of *time*.

To say that a certain volume of water (the run-off from the watershed) must ultimately reach its destination in the natural drainage basin is practically equivalent to asserting that the law of gravity is a controlling factor

in flow, and the relative pertinency of these assertions, so far as present issues are concerned, is not dissimilar.

It should require no argument to demonstrate that *time* is one of the most important elements in the effect of flow as productive of flood conditions. This, for the reason that the more the flow is retarded or restricted, the greater the opportunity for evaporation and other factors which diminish the volume of ultimate discharge.

Broadly speaking, in the latitude in question where the average annual precipitation is approximately 24 inches, 22 inches, in round figures, is lost by evaporation and other causes and never reaches the drainage basins.

See Hydrology (Adolph F. Meyers, 1st ed.) p. 428.

This author compiles statistics covering the run-off of the water-sheds of the Mississippi, Minnesota, Root, Otter Tail and St. Croix rivers in Minnesota, disclosing an average annual loss from evaporation of 21.3 inches.

When, therefore, the defendant propounds the hypothesis that a given volume of water would have reached Lake Traverse in any event, because of the capacity of its natural discharge channel, it is self-evident the result thus postulated depends on a variety of facts so complex and indefinite, as to destroy any practical value of the assertion.

There are, however, certain physical features of unmistakable significance disclosed in this case, viz: the character of the water-shed in question in its natural state, which, as already disclosed, tended to retard run-off and the limited capacity of its single discharge channel. The existence of these physical conditions and their necessary effect on the drainage of the area are sufficiently confirmed by the expenditure of approximately $1,000,000. for the local public ditching, which required and

made necessary, the state ditch in question, for its effectiveness.

If the only results of the artificial system thus created was to operate and provide such an excess discharge as that computed by Professor Bass, its futility is apparent. The contrary is so obviously true as to demonstrate the puerility of the theory propounded by him.

We have already presented a series of computations disclosing the relative contributions of the natural and artificial channels to the volume of ultimate discharge in Lake Traverse. Under natural conditions, this volume can only be approximated by comparison with the run-off of other areas, of relatively similar character and size, in the same general section of the country. It is unnecessary to repeat the data and conclusions on this feature of the case.

If it be claimed that such comparisons do not furnish a fair criterion, there is no other criterion except the volume of run-off in previous years, in which the conditions of precipitation were not essentially dissimilar, and in which, it has already been shown, the accessions to the waters of Lake Traverse were insufficient to produce floods in any wise comparable to those of the years 1915 and 1916 with which we have to deal.

The creation of a new, independent and enlarged outlet for the watershed has necessarily effected a material change in the physical conditions. If technical features relating to the relative discharge capacity of the new, as compared to the natural channel, be eliminated and it be assumed, for purposes of argument only, their capacities are substantially equal, the result is that when both are discharging to capacity, *the volume reaching Lake Traverse, at a given time, is double that which would*

have reached the Lake, at the same time, under natural conditions.

The same factors hold good whatever hypothesis be assumed for the stage of the waters in the drainage area at any particular time. This, for the reason, that a stage which would lower the volume of flow in one, must have substantially similar effect on the other. As a result, whatever conditions may be assumed for the drainage area, the volume of discharge in Lake Traverse, *at any one time*, is practically doubled.

These results must be considered for their effect on the Lake itself, which is conceded to have been a natural detaining basin or reservoir, in its relation to areas down stream. Of course, it is the excess of in-flow, over out-flow, that over-taxes the capacity of any such natural reservoir and causes floods in the lower area. The accession of *greater volume at the same time*, is the factor that creates *this excess*.

The theory propounded by the defendant's expert ignores or overlooks these elementary considerations, which are in reality decisive and seeks to substitute therefor, deductions devoid of even plausibility.

3. But for unduly extending the present argument, it could be shown that Professor Bass has adapted practically his entire processes of reasoning to forcing desired results, regardless of principle or rule. In the impractical concept of Twelve Mile Creek as the dominent stream, the theory of velocity, predicated of channel bottom slope, was frequently emphasized. The natural slope or fall of the land which supplies the element of gravity; the slope of the water surface which necessarily follows the slope of the land and the factor of depth, in determining velocity and consequent discharge, are ignored.

For the same general purpose, resort is had to the idea of separating the Mustinka watershed into distinct areas. In seeking to emphasize the flow of Twelve Mile Creek, the startling assertion is made that the moraine zone (an area of hills and valleys) was not conducive to rapid run-off.

In dealing with the element of precipitaion, reference is repeatedly made to percentages, compared with the normal and extending over relatively long periods of time, such as several months or more and characterized, to illustrate, as 25% or 50% above normal. These references are obviously misleading and ignore the fact that from the standpoint of definiteness, they are utterly worthless as well as meaningless generalizations, as shown by Dean Shenehon, *supra*. An excess of 25% precipitation, over normal, spread over the year, would show the negligible amount of .5 of an inch per month. The same is true if the period of several months be taken, in which the excess of such assumed percentages might represent a fraction of an inch.

It goes without saying, that a theory, requiring for its support, reliance on matters as impractible as those suggested, hardly merits serious attention.

As still further illustrative of the distinctly misleading data employed, attention may be directed to defendant's Exhibit 76, Rec. 2184, disclosing in chart form the annual precipitation for the years 1902 to 1916, inclusive; also, the run-off in coresponding year from *"the drainage area of the Red River at Moorhead, Minnesota."*

The purpose of this chart is obviously to permit visualizing the claim that excessive precipitation, in the years 1915 and 1916, accounted for the floods in those years.

In what is therein disclosed in reference to precipitation, the chart confirms the claim of complainant that there was nothing in the years 1915 and 1916 essentially differing from a number of previous years such as 1905 and 1906..

As respects the run-off disclosed by this chart in the corresponding years, the showing is distinctly misleading, unless it is clearly understood to what it relates. To illustrate, by reference to the chart it will appear that the run-off as there disclosed was materially greater in 1906 and 1907 than in 1915. In fact, 1915, as thereon depicted, would appear comparable to a series of preceding years. On the other hand, 1916 discloses a far greater run-off than any previous year.

These seeming discrepancies are explained when it is seen this chart *has no direct reference to the Bois de Sioux Valley*. It is projected for Moorhead which is *approximately eighty miles north of the area in question*. The conditions of the run-off indicated by the chart represent therefore, the *cumulative effects* of the Bois de Sioux, Rabbit, Otter Tail and Wild Rice Rivers, all of which have their confluence in the Red River of the North at various points, north of the area here in question. Hence, the varying conditions of the independent watersheds of all these rivers are reflected at Moorhead. The possibilities of variance in any or all of the conditions of these watersheds, in their relation to the resultant run-off, deprives the chart of materiality as disclosing conditions in any wise pertinent or material to the area with which we have to deal.

4. It was suggested by defendant's counsel, on the examination of complainant's experts, that the conceded fact of ten inches run-off in the month of June, 1914, without flooding in the Bois de Sioux Valley, was inconsistent

with complainant's claim in this case. This was based on the fact the ditch was substantially completed in that year. The evidence discloses the ditch was completed in the summer or fall of 1914 to a point approximately 2½ miles from its ultimate outlet in Lake Traverse. If no other factor were considered than those thus suggested, it might be claimed with some degree of plausibility that the relatively short distance, between the points to which the ditch had been completed and its ultmiate outlet, would only result in temporary delay of the flow. The variety of other factors, however, entering into resulting flood conditions in the Bois de Sioux Valley cannot thus be ignored. In other words, conditions of temperature, wind, the extent to which the soil of the watershed had been dried out by the ditches and other conditions not necessary to be detailed, govern what the experts term the complex of run-off.

The largely determinative feature however, so far as flooding in the Bois de Sioux Valley is concerned, was the condition of Lake Traverse in 1914. If the Lake at the time of the accession of the waters from the June precipitation was at or below normal (974), it would receive practically a foot of water without serious overflow.

This suggestion is confirmed by one peculiar feature disclosed by the facts. *There was a flood condition in the Bois de Sioux Valley in the fall of 1914* resulting in the inundation of an area approximately one-third of that inundated during the floods of 1915 and 1916. Rec. 82 (140). The results in this regard disclose that the reservoir capacity of Lake Traverse had been so far impaired by the accession of the waters of the drainage area, as to render it incapable of receiving the normal run-off without overflow. In other words, the accession from the June precipitation unquestionably raised the mesne level

of the Lake to such an extent that the normal run-off in the succeeding months, accelerated as was that normal run-off by the ditch construction, produced the flood in the fall of 1914 in the Bois de Sioux Valley.

Emphasis was similarly laid by counsel for defendant on the circumstance that flood conditions existed in the delta zone, during the spring of 1917 and also in the area below the cut-off and above the outlet in Lake Traverse, while no flooding manifested itself in the Bois de Sioux Valley. This was similarly claimed to be inconsistent with the theory of complainant.

It has already appeared that the floods of 1916 receded in the fall of that year, until the inundated lands in the valley were clear and the waters confined within the channel of the Bois de Sioux River. This necessarily presupposed a corresponding discharge from Lake Traverse down at least to normal or below. The total precipitation during the last four months of 1916 was slightly in excess of one inch per month. (Exhibit 76, Rec. 2184.)

The precipitation during the winter months of 1916-1917 was negligible. Thus, but for the artificial conditions, tending to increase and accelerate the run-off, *there was nothing to cause floods even in the delta zone.* These flods were clearly due to the artificial conditions. The floods in the area below the cut-off and between that point and the Lake are ascribable to the same thing, as explained by Dean Shenehon. Rec. 472 (721.) The water levels may have reached a relatively high stage owing to the rapidity of the accelerated discharge. The volume, however, was insufficient to surcharge Lake Traverse and in consequence, no resultant floods occurred in the Bois de Sioux Valley. Had the conditions thus indicated been followed by heavy precipitation during the succeeding summer of 1917, with Lake Traverse raised as it necessar-

ily would have been by the accession of the waters from the spring floods, a repetition of the floods of 1915 and 1916 would have been inevitable. As it was, 1917 turned out to be one of the driest years of which there is any record in that section of the country.

Furthermore, the conditions in the spring of 1917 in the Mustinka River Valley, in the general area of the confluence, were unusual, as testified to by defendant's witness Ringdahl. (Rec. 619-620.) The break-up came before either the natural or artificial channels were open, and, lacking outlet, local floods were inevitable. These conditions account for the more or less general statements of various witnesses for the defendant, to the effect the flooding conditions in 1917 were not essentially dissimilar from those existing in the two previous years.

The inaccuracy of these generalizations is sufficiently attested by the fact of the almost total absence of precipitation during the winter of 1916-1917, without which there was, of course, nothing to produce floods comparable to those of the previous years. Lacking outlet, the area of the confluence would necessarily present a flooded condition, for a relatively short period of time, until the discharge channels were opened and commenced functioning.

The opening of these channels naturally had the effect of transferring the flood down stream, to the area beyond the outlet of the cut-off, thus explaining what was stated by defendant's witness Heggan, as already noted, that there had been little rain that spring and no unusual amount of snow during the winter. He couldn't explain it, yet, the floods in that area were substantially as high as in 1916.

The whole situation, as thus attested, is entirely consistent with and confirms complainant's theory, that the

operative effect of the ditching was to destroy the delta zone as a detaining basin and even under conditions of relative drouth, to accelerate and transport the accumulated waters to the area below the zone.

In this latter area, spread as it was over a relatively large surface, the flow was necessarily retarded, hence, lessening the ultimate discharge into Lake Traverse. The lack of spring floods in 1917 in the Bois de Sioux Valley is thus explained from the circumstances (a) the lack of precipitation; (b) the lack of functioning of the ordinary discharge channels at the start of the floods; (c) the retarding of flow due to the overflow of the land, and (d) the fact that Lake Traverse was at a stage where its reservoir capacity could carry the burden of the relatively limited floods at this time.

5. Conclusion With Reference to Defendant's Case.

The matters thus far considered have, we think, covered the substantative features of the defendant's case. No time has been devoted to the testimony of the witness Sardeson for the reason his confessed lack of experience destroys whatever of value might otherwise be accorded his opinions. The case of the defendant must, we think, stand or fall with the conclusions of Professor Bass, which have already been sufficiently discussed.

After all is said, the Court will not fail to be impressed, with the fact that Minnesota has resorted to a system of internal improvements, aimed at the accomplishment of a self-evident objective purpose, viz: the drainage of a comparitively large area within that state. This has been accomplished through a system of what are known as county and judicial ditches, which are referred to in this

record as the local ditches. The entire system has been made effective by the direct action of the state itself, in providing an artificial discharge channel into the natural outlet. It is, we think, fairly and reasonably to be inferred that this complicated system has served to drain the area in question to a greater extent than would have occurred under natural conditions. It is equally fair to assume that this drainage has resulted in bringing a far greater volume of water into the natural outlets than would come in a state of nature.

These are the conditions which are productive of floods and following their installation, we find floods of greater magnitude than any previously recorded. The conclusion is seemingly inevitable. In attempting to escape the consequences, Minnesota has had recourse to the variety of theoretical contentions already discussed. The results in this respect must be ascribed to the necessities of the case and the absence of adequate and practical reasons which would sustain its claims.

Having assigned the resulting floods to conditions for which Minnesota is responsible, it only remains to be determined what are the legal principles governing conditions of this kind, arising between independent states and the nature of the appropriate relief.

For the convenience of the Court, an abstract of the evidence of complaint's experts on rebuttal, relating to the matters last reviewed, is added as an appendix to this brief.

VII.

Legal Principles Governing the Rights and Obligations of the Respective Parties.

The subjects under this heading will include the ascertainment of,

(a) The system or principles of law determinative of a controvery, such as that here presented, between States:

(b) The rules settled by that system and determinative of such controversy; and

(c) The nature and measure of relief.

These will be considered in the order stated.

(a) The Rules Established by the Common Law are Applicable in Controversies Between States.

The conclusions involved in this heading are clearly foreshadowed by the decisions of this Court in the *Missouri and Kansas-Colorado* cases already reviewed. Broadly speaking, the principles, recognized as determinative of the questions presented in those cases, are equally applicable here. Both presented questions dealing with the rights and obligations of States, occupying the respective status of upper and lower proprietors on the same water course.

The *Missouri* case presented the question of the stream's pollution by the upper proprietor with consequent injury to the lower. While the opinion considered this question as one of jurisdictional character, it is clear (and the later decisions of this Court have so stated) that it went to the merits and the case was decided accordingly. Thus it was broadly assumed that the principles of the common law were applicable and decisive, but that the complain-

ant was not entitled to the relief sought, for the reason of failure to establish its case on the facts.

In the *Kansas Colorado* case as first presented, the situation was the same. The case turned on the right of the upper proprietor to appropriate and divert the waters of a stream, to an extent materially diminishing the natural flow, with consequent injury to the lower proprietor. Colorado, in this case, postulated its contentions of the absolute and unrestricted rights of a sovereignty state in the waters within its limits, to the exclusion, if need be, of the rights of others outside those limits. Kansas, on the other hand, asserted the application between states of the principles of common law which deny to the upper propietor the right to materially impair the flow of natural water courses to the damage of the proprietor below. Broadly speaking, the contention of Kansas was sustained and the case decided on consideration of the fact that the proofs did not establish the contended impairment of flow.

See *Kansas v. Colorado*, 206 U. S. 46.

The case at bar similarly turns upon consideration of the rights of the upper and lower proprietors on natural water courses, where, as in the cases last referred to, the proprietors are separate states. The same rules which deny to an upper proprietor the right to pollute a stream or to divert or impair the natural volume of flow to the damage of the lower, are seemingly applicable with like force and effect, where the question turns on the right of the upper proprietor to surtax or surcharge the capacity of a natural water course, with the consequent flooding and inundation of a lower.

While strictly speaking, as indicated at an earlier point in this brief, it may not be technically correct to assert that common law principles are applicable and determina-

tive of the rights as between independent states, it is clear that recourse to some system of jurisprudence is necessary for the solution of such questions and that that solution must be found either upon application of the principles of common law or those of international law.

This question was presented and considered by this Court in *Kansas v. Colorado, supra,* (206 U. S. 46, 95-98,) from which the following is excerpted

> "Now, the question arises between two states, one recognizing generally the common law rule of riparian rights and the other prescribing the doctrine of the public ownership of flowing water. *Neither state can legislate for or impose its own policy upon the other.* A stream flows through the two and a controversy is presented as to the flow of that stream. It does not follow, however, that because Congress cannot determine the rule which shall control between the two states or because neither state can enforce its own policy upon the other, that the controversy ceases to be one of a justifiable nature, or that there is no power which can take cognizance of the controversy and determine the relative rights of the two states. Indeed, the disagreement, coupled with its effect upon a stream passing through the two states, makes a matter for investigation and determination by this Court. It has been said that there is no common law of the United States as distinguished from the common law of the several states."

Continuing the opinion quotes from Western Union *Telegraph Company v. Call Publishing Company,* 181 U. S. 92, as follows:

> "Properly understood, no exceptions can be taken to declarations of this kind. There is no body of Federal common law separate and distinct from the common law existing in the several states. * * * But it is an entirely different thing to hold that there is no common law in force generally throughout the United States. * * * The common law includes those principles, usages and rule of action appli-

> cable to the government and security of persons and property, which do not rest for their authority upon any express and positive declaration of the will of the legislature."

Continuing, the Court quotes from the opinion of Chief Justice Fuller in the previous decision of the same case (185 U .S. 146) as follows:

> "Sitting, as it were, as an international, as well as domestic tribunal, we apply Federal law, state law, and international law, as the exigencies of the particular case may demand."

Concluding the opinion states the following:

> "One cardinal rule, underlying all the relations of the states to each other, is that of *equality of right*. Each state stands on the same level with all the rest. It can impose its own legislation on no one of the others, and is bound to yield its own views to none. Yet, whenever, as in the case of *Missouri v. Illinois*, 180 U. S. 208, the action of one state reaches through *the agency of natural laws into the territory of another state*, the question of the extent and the limitations of the rights of the two states becomes a matter of justiciable dispute between them, and this court is called upon to settle that dispute in such a way *as will recognize the equal rights of both and at the same time establish justice between them*. In other words, through these successive disputes and decisions this court is practically building up what may not improperly be called *interstate commerce law*." (Italics ours.)

The authoritative character of the principles thus announced has been recognized in the following cases:

Slyvester v. the State of Washington, 215 U. S. 80.

Rickey etc. Co. v. Miller & Lux, 218 U. S. 258.

Bean v. Morris, 221 U. S. 485.

Marshall etc. Co. v. State of Iowa, 226 U. S. 460.

The doctrine of equality of right between the states

is wholly inconsistent with the contention of Minnesota in this case, which presupposes, as already stated, that that state may adopt such measures as it sees fit for the improvements of its domain and the welfare of its citizens, regardless of the consequences to neighboring commonwealths or the latter's citizens.

The circumstance that Minnesota, in the accomplishment of these purposes, has observed all of the requirements of its own laws and perchance, its own conception and interpretation of what is sanctioned by the common law, is not decisive. The controlling question here has to deal with the natural and necessary consequences of what has been done, and its effect on others, *whose rights are equal* to those of Minnesota herself.

The limitation therefore, must be found in the principle that whatever right Minnesota may be assumed to have possessed, its exercise was restricted to the point, where unlawful injury would necessarily result to those whose rights were co-equal with her own.

MINNESOTA HAS NO LEGAL RIGHT TO APPROPRIATE OR USE INTERNATIONAL WATERCOURSES IN ANY MANNER UNREASONABLY BURDENING OR OVER-TAXING THE CAPACITY OF THOSE WATERCOURSES TO THE INJURY AND DAMAGE OF OTHERS WHOSE RIGHTS THEREIN ARE CO-EQUAL WITH HER OWN.

The principle thus indicated necessarily follows from the application of the general rules already considered. The conclusion is a necessary consequence of the broader and well established rule of equality of right, which was recognized and expounded in the *Kansas-Colorado* case *supra*.

The doctrine of equality of right is fundamental and by no means limited to cases arising between states. It is equally applicable in cases involving private rights in the same state. The rule has been thus stated.

> "Certain correlative rights and duties exist between the owners of land through which a watercourse runs. These rights are vested property rights of which the riparian proprietor cannot be deprived, even by the state, without compensation as in the case of the taking of other property, and are entitled to protection to the same extent as other property rights. * * * These rights are not easements or appurtenances, but are inseparably annexed to the land and are parcel of the land itself, and have been designated as natural rights and said to exist *jure naturae*."
>
> Vol. 30, Am. & Eng. Ency. of Law, (2nd. Ed.) p. 352 and cases cited.

The correlative rights thus suggested are reflected in the equally recognized and well settled rule which, for convenience, may be termed that of "reasonable use."

This was applied by this Court in the *Kansas-Colorado* case and had been recognized in a series of previous cases.

> See *Atchison v. Peterson*, 20 Wall. 507.
>
> *Howard v. Ingersoll*, 13 How. 381, 426.
>
> *Head v. Amoskeag Mfg. Co.* 113 U. S. 9.
>
> *United States v. Rio Grande Irrigation Co.* 174 U. S. 690.

The rights of the complainant therefore, in this case, may be broadly rested on those which are the natural incidents of its proprietory status, as owner of lands bordering a natural watercourse, and, equally on the right of preservation and perpetuation of the natural conditions therein.

It is unnecessary, for the purposes of this case, to con-

sider the various rights to which this status gives rise, or the reciprocal obligations consequent thereon, as we have here only to deal with the concrete situation, resulting from over-taxing and surcharging the capacity of a watercourse, through artificial agencies, by an upper proprietor, resulting in flooding a lower.

We are similarly not concerned with the rights of Minnesota, as respects the disposition of the surface waters of that state or the drainage and reclaimation of areas therein, by artificial means. This, for the reason that however broadly these latter rights may be asserted, their exercise is limited, where natural watercourses are concerned, by the rules stated below.

We have similarly no concern with the differing principles of the common and civil law with respect to drainage of surface water.

See *Walker v. New Mexico R. R.* 165 U. S. 602.

The solution of the questions, with which we are called upon to deal, is found in determining the extent to which a natural watercourse may be employed by an upper proprietor for his own purposes.

In Vol. 2, *Farnum Waters and Water Rights,* Sec. 186, the rule in this respect is thus stated:

> "In accordance with this principle the flow of the water into the natural streams may be hastened so long as the water is not caused to overflow the banks of the stream to the injury of the land through which it flows. But one landowner cannot be permitted to relieve himself of a burden by casting it upon his neighbor, and so the flow of the water cannot be hastened into the stream to such an extent that the stream cannot dispose of it and the result is to cast it from the highway onto the lower land in a body, to its injury."

At Section 207a, the same author states as follows:

> "As has already been seen, the streams are the great drains which are provided by nature to carry off the rain which falls upon the earth, the water coming from melting snow, and the water which comes to the surface in the form of springs. The right to utilize these drains to carry the water which would naturally find its way into them, so far as they may be used without inflicting injury upon the riparian owner, is absolute. * * * The principles at the foundation of these decisions is the same that governs the dealing with surface water generally. One landowner is not permitted to relieve himself of a burden actually resting upon his land to the injury of his neighbors. *Sic utere tuo ut alienum non laedas* is the maxim which governs the relation with respect to surface waters; and it is immaterial in its effect upon the liability of the wrongdoer whether the water is cast directly from the upper onto the lower ground, or whether it is cast into the stream in such quantities that the stream no longer can convey it, so that it spreads over the adjoining land to its injury.'

See also Vol. 3, *id.* Sec. 885.

In Vol. 30 Am. & Eng. Ency. of Law, (2nd Ed), pp. 343-344, the rule is thus stated:

> "This right of drainage into watercourses is, however, subject to the qualification that one land owner cannot by artificial means, to the damage of other owners, increase the volume of surface water flow into a watercourse beyond the natural capacity thereof."

At p. 354 the same authority states as follows:

> "As a general rule, a riparian owner is entitled in the absence of grant, license, or prescription limiting his rights, to have the watercourse which washes his lands flow, as it is wont by nature to flow, without material alteration or diminution as to either quantity or quality."

In Vol. 40, Cyc. p. 648, the following is stated:

> "The owner of the land has the right to collect the surface water and the natural drainage of his land into ditches, drains, or artificial streams and discharge it into a natural watercourse on his own land, which is the natural outlet of the waters so collected, and is not liable to lower proprietors, although, by this arrangement, the flow of the waters is accelerated and increased, provided the discharge is not beyond the natural capacity of the watercourse."

In Gould on Waters, Sec. 274 the rule is stated in substantially the same language as that last above quoted.

See also, *Jackman v. Arlington Mills*, 137 Mass. 277.
Noonan v. Albany, 79 N. Y. 470.
McCormick v. Horan, 81 N. Y. 86.
Walshe v. Dwight Mfg. Co. 178 Ala. 310.
O'Brien v. St. Paul, 18 Minn. 182.
Baldwin v. Ohio Township, 70 Kan. 102.

For an exposition of the governing common law principle, see opinion Brewer, Justice, in *Gibbs v. Williams*, 25 Kan. 214, cited and quoted with approval by this court in *Walker v. New Mexico Ry.* 165 U. S. 593, 603, *supra*.

In *Grant v. Kuglar*, 81 Ala. 637, it is stated:

> "The principle upon which we rule this case is, that water having *a time relation* as well as *a space relation*, both of them being fixed by nature, there is no more right in an adjacent proprietor *to alter the one than the other*. If the time realtion to the stream is so altered that the effect of the water upon the lower tract is injuriously different from what it was by the natural flow of the stream, then a wrong has been done to the proprietor of the lower tract. We think that the owner of water has no more right, artificially, to project it forward on another man's land than he has to push it back upon land in his rear; and if, by so doing he causes damage, he ought to answer for it."

To the same effect Vol. II, *Farnum Waters etc.* p. 1632.

In *Tillotson v. Smith*, 32 N. H. 90, it is said:

> "Every owner of land situate upon a stream has a right to the natural flow of the stream; a right to insist that the stream shall continue to run *uti curren solebat;* that it shall flow upon his land in its usual quantity, at its natural place, and at its usual height, and that it shall flow off his land upon the land of his neighbor below in its accustomed place and at its usual level. This right he has as an incident to the property of his land and he cannot be deprived of it but by grant, actual or presumptive. Whenever, by reason of the interference of the owner above * * the water of the natural stream is made to flow upon his land at different place from its natural channel, or at a different level, or in an unnatural manner * * * and actual injury ensues to any material amount, the owner of the land may maintain an action for such injury. In short, if any person, above or below, shall make any change in the natural flow of the stream, to the material injury of the owner situate upon it * * * he is liable for the damages he may occasion."

To same effect, *Mayor and City Council of Baltimore v. Appold*, 42 Md. 442.

Hyatt v. Albro, (Mich.) 80 N. W. 461.

Oregon Iron Co. v. Trullenger, 3 Ore. 1.

McKee v. Delaware etc. Canal Co., 125 N. Y. 353.

Cases, in which a contrary rule has been announced, are referable either to the recognition in those jurisdictions of the doctrine of the civil law or have resulted, as explained by Mr. Farnum from confusion of the rules relating to drainage with those relating to watercourses.

See Vol. 3, Farnum on Waters, Sec. 889d.

While, for obvious reasons, the decisions of the Minnesota Court are in no wise controlling in the disposition of the present controversy, a brief review will disclose the courts of that state have been on both sides of the propo-

sition involved, starting with the full recognition of the common law principles in the earlier cases and ending by promulgating rules repudiating the common law and establishing a doctrine peculiar to that state.

The common law rule was recognized in *O'Brien v. St. Paul,* 18 Minn. 182, *supra,* which was followed by *Hogenson v. St. Paul, etc. Ry.,* 31 Minn. 224; *Olson v. St. Paul, etc. Ry.,* 38 Minn. 419; *Jordan v. St. Paul, etc. Ry.,* 42 Minn. 172; *Rowe v. St. Paul, etc. Ry.,* 41 Minn. 384.

A contrary rule was announced in *Sheehan v. Flynn,* 59 Minn., 436 which, to all practical intents and purposes overruled the earlier cases. The *Sheehan case* was followed and approved by a divided court in *Gilfillan v. Schmidt,* 64 Minn. 29, Chief Justice Start and Associate Justice Buck dissenting.

In *State ex rel Wickstrom v. Board of County Commissioners,* 98 Minn. 89, it was held that the doctrine of the *Sheehan* case should not be extended to cover the case of public county ditches and in *Erhardt v. Wagner,* 104 Minn. 258, 261, it was held in substance that the rule stated in the dissenting opinion of Associate Justice Buck in *Gilfillan v. Flynn, supra,* was correct.

Later cases however, recognize the *Sheehan* case, the last decision being *Hartle v. Neighbauer,* 172 N. W. 498, from which we excerpt the following:

> "It has become thoroughly settled law in this state, that a land owner may rid his land of the common enemy known as surface water by artificial drains and ditches provided reasonable care be taken to inflict no unnecessary injury to the land of his neighbors. It has been said that the rule is peculiar to this state, a distinct departure from the rule of the common law as stated and applied in *Hogenson v. St. Paul, etc. Ry.,* 31 Minn. 224, and other like cases preceding the *Sheehan* case and not followed in other jurisdictions. 3 Farnum on Waters, 2577, 2608.

> The criticism is probably sound. But that is not here important."

Further consideration of the local law is, therefore, uncalled for.

We need not pause to consider the technical distinction suggested by some of the cases, viz: whether the overflow waters of the Mustinka River in the delta zone had lost their character as surface waters (see *Crawford v. Rambo*, 44 Ohio State. 279, and cases cited) for the reason that in this case questions relating to drainage are incidental and those relating to watercourses controlling.

The complainant rests its contention on this branch of the case, on the general principle that where equality of right with respect to natural watercourses concededly exists, that right is wholly inconsistent with the assumption of any theory of servitude which would result in its destruction.

Lake Traverse and the Bois de Sioux River, for all the purposes of this case, constitute natural watercourses and no conceived benefit to Minnesota justifies employing or subjecting those watercourses to an unnatural burden, with consequent damage and injury to complainant.

COMPLAINANT IS ENTITLED TO AN INJUNCTION RESTRAINING THE FURTHER CONTINUANCE OF THE TRESPASS AND AN ASSESSMENT OF THE DAMAGES ALREADY SUSTAINED.

It should require no argument or citation of authorities to demonstrate the matters stated in this heading. The unlawful overflowing or flooding of lands presents the ordinary incidents of trespass and nuisance against which it is well established that equity alone can afford adequate relief. The rule is stated in Vol. 40 Cyc. p. 656, as follows:

"In case of injury to real property by the unlawful accumulation or discharge of surface water upon it, equity will give relief by injunction, not only to restrain the continuance or repetition of the unlawful and injurious acts, but also to prevent the carrying out of a project or work which is threatened and which will clearly have the injurious effect anticipated. * * * * The injunction, if granted, will be moulded to suit the relative rights of the parties, and may take the form of a mandate to compel the removal of the cause of the injury and a restoration of the land to its former condition."

See also Vol. 22, Ency. of Pl. & Pr., 1155.

2, *Farnum Waters and Water Rights*, Secs. 451, 483, 582.

Jacobson v. Van Boening, 48 Nebr. 80.

Carlson v. St. Louis etc. Co., 73 Minn. 128.

Morrill v. St. Anthony Falls Co., 26 Minn. 222.

The jurisdiction thus invoked proceeds from application of the well settled rules that the legal remedy is inadequate where the case requires preventive relief; where the remedy at law can only be worked out through successive actions for damages and where, but for intervention of equity, the loss will be irreparable.

Cruikshank v. Bidwell, 176 U. S. 73.

Smyth v. Ames, 169 U. S. 466.

Franklin Telegraph Co. v. Harrison, 145 U. S. 459, 474.

The jurisdiction may be equally referred to the settled rule that the remedy at law, in order to exclude the concurrent remedy in equity, must be as complete, as practical and efficient to the ends of justice and its prompt administration as the remedy in equity.

Watson v. Sutherland, 5 Wall. 74.

Kilbourn v. Sunderland, 130 U. S. 505.

Walla Walla v. Walla Walla Water Co. 172 U. S. 1.

The jurisdiction in equity having attached, it is equally settled it will be retained to administer all of the relief which the nature of the case demands and which is necessary to a final determination of all matters in issue.

United States v. Union Pacific Ry. Co., 160 U. S. 1, 152.

Vol. 1, *Pomeroy's Eq. Jur.*, (3rd. Ed.) Sec. 181.

Lynch v. Metropolitan etc. Ry. Co., 129 N. Y. 274.

It necessarily follows that as applied to a case such as that at bar, the Court will grant not only equitable but also legal relief, including an injunction and damages.

Predicated of the assumption the case has shown the features of trespass and nuisance, as already stated, and that the conditions which have been responsible therefor in the past threaten repetitions of the same injury in the future, it is well settled under the authorities that the injunctive relief will be adapted to the facts of the particular case and directed to the abatement of the unlawful conditions.

Pennsylvania v. Wheeling etc. Bridge Co. 13 How. 514.

Howard v. City of Buffalo, 122 N. Y. Supp. 1095.

Sallon Sea Cases, 172 Fed. 792.

Carver v. San Pedro etc. Ry., 151 Fed. 334.

Western Union Tel. Co. v. Postal Tel. Co., 217 Fed. 532, 539.

Allen v. Stowell, 145 Cal. 666 (104 Am. St. Rep. 80.)

Wilheit v. Billings etc. Co. (Mont.) 101 Pac. 168.

Falsom v. Boyce, (Ia.) 142 N. W. 427.

Rothery v. New York etc. Co. 24 Hun. 172.

Durga v. Lincoln etc. Co. (Wash.) 92 Pac. 343.

Carpenter v. Gold, 88 Va. 551.

Corning v. Troy etc. Factory, 34 Barber, 492 (s. c.

40 N. Y. 191.)

Atchinson etc. Ry v. Long, 46 Kan. 701.

Brauns v. Glesige, (Ind.) 29 N. E. 1061.

The foregoing cases have been selected from a variety of jurisdictions as broadly indicative of the underlying question presented in this case, viz that where the rights of riparian proprietors are impinged by obstructing or increasing the natural flow; by damming back the waters from below or discharging an excessive volume from above, equity will grant that form of injunctive relief adapted to the circumstances of the particular case and necessary to prevent a further continuance or repetition of the wrong.

The cases cited disclose such injunctive relief has assumed prohibitory or mandatory form, according as one or the other was necessary to effectuate the purposes of the decree.

The rule is thus stated in Vol. 1, Pomeroy's Equitable Remedies, Sec. 533.

> "The relief sought in equity against nuisance is, of course, preventive, either to prohibit the creation of a nuisance or to prevent an existing one from continuing in the future. Ordinarily, this end is achieved by a mere prohibitive injunction. When, as is not uncommonly the case, however, the nuisance is one which exists, and will continue to exist, because of acts already done—as, for example, the building of a dam—without further acting on the defendant's part, mere prohibition will not serve to accomplish the desired result; mandatory relief is necessary to end the wrong. * * * On this ground the use of mandatory injunctions is resorted to whenever necessary to give the full relief to which the plaintiff is entitled."
>
> See generally *In re Lennon,* 166 U. S. 548, 566.
>
> *Mugler v. Kansas,* 123 U. S. 623, 673.

In the case at bar, the objective of the decree, is obviously to abate the nuisance — the unlawful flooding of complainant's territory. Complainant is entitled to the restoration of the natural conditions, without which, it cannot be adequately protected against repetition of the wrong which has already occurred and which, without such restoration, will inevitably re-occur.

If practical difficulties suggest themselves, the results, in this respect, present nothing for which complainant is in any wise responsible. Minnesota is in no position to seriously urge consideration of any such difficulties. In fact, emphasis by Minnesota of such claims would be tantamount to making capital out of her own wrong.

The facts disclose the trespass here complained of has resulted from an unlawful act, viz the imposition of a burden on a natural watercourse, that Minnesota has no lawful right to impose. The agencies, through which this unlawful act has been accomplished, may be considered as lawful or unlawful, according as they are viewed on the one hand, independently of the results ascribable to their action, or, on the other hand, as the responsible cause of the unlawful act.

As it is the unlawful act which is to be enjoined, the decree need not concern itself with the particular agencies of its accomplishment. While the decree may be predicated of the fact that the continuation of the agencies will be productive of the same injurious consequences in the future that have already resulted from their existence or operation in the past, they are, in reality, incidental so far as the decree itself is concerned. This, for the quite obvious reason, that if a continuance or repetition of the trespass, resulting from the unlawful act, be enjoined by the decree, there is necessarily embraced, every agency

within the defendant's control that might cause or contribute to a violation of its mandate.

From this standpoint, the agencies may be regarded as wholly immaterial so far as the decree itself is concerned.

The disposition of the agencies which are disclosed to have been responsible for the trespass may therefore, be considered as a matter for Minnesota to determine for itself, subject, of course, to the obligation that whatever disposition be made thereof, they be so controlled as to preclude their directly or indirectly contributing in the future to a repetition of the unlawful act.

These latter features are suggested in anticipation of the possible claim by Minnesota of the impracticability of modifying, much more obliterating, the artificial drainage system constructed within her borders and which has constituted the agency, through which the trespass here complained of has been committed. Any such claim, if made, is clearly without merit.

Minnesota obviously will not be permitted to assert that the magnitude of an agency created by her, or the difficulties involved in its control, should relieve her from the responsibility of restraining its unlawful propensities. Otherwise, were such claim to be allowed, it would be tantamount, as already stated, to Minnesota's making capital out of her own wrong and make the test of whether Minnesota should or should not recognize her legal obligation, depend on the question of her own convenience.

Hence, so far as the decree and its effective mandates are concerned, there is no occasion for emphasizing the feature of the agencies involved. The right to enjoin a repetition of the wrong is undoubted. This must be accepted as the starting point. If it is physically impracticable to avoid the wrong without removing the agencies,

they must be removed. Otherwise, their removal is not essential. These are matters, as already stated, for Minnesota herself to determine and the law does not interest itself with such determination provided its mandates be observed.

The matters thus far considered, cover the feature of injunctive relief and leave only for determination the subject of damages.

THE DAMAGES SUSTAINED AS A RESULT OF THE TRESPASS.

That complainant is entitled to a decree for damages has been sufficiently indicated in the authorities already cited. The result in this regard follows the commission of the trespass, with the consequent loss and destruction of property rights.

The principle on which these damages are to be ascertained, in a case of this character, is not free from difficulty.

The first question which immediately propounds itself is whether the rule or measure of damages, established in cases of similar character where the rights of private litigants are involved, is applicable in a case between States?

If this be answered in the affirmative, it remains to be determined by what rule that damage is to be ascertained; that is, whether it is to be decided with reference to the laws or rules, if any, prevailing in either or both of the States involved or upon application of the theory that the common law is one and the same in all of the States and as such, in a cause depending in the Federal Courts to be interpreted by those courts regardless of State decisions, as originally expounded in *Swift v. Tyson*, 16 Peters, 1.

These matters having been determined, the further inquiry is suggested whether the rule or measure of damages, in such a case, is the same in equity as at law?

If this be answered in the affirmative, it must next be determined whether the damages are to be ascertained from the standpoint of a "continuing trespass" and therefore to be assessed to the commencement of the action, reserving the right to successive actions for future damages, or, from the standpoint that the cause or agency of the wrong is of permanent character and the damages to be assessed, in consequence, in a single action.

Finally, the several questions thus suggested aside, whether a case such as this may be considered as one where the court, in the exercise of an assumed equitable discretion, would be warranted in fixing permanent damages and granting what is termed alternative injunctive relief, in other words, conditioning the injunction on the defendant's refusal to pay the award, within the principle announced in *New York City v. Pine*, 185 U. S. 93, 108.

In the absence of guiding precedent, no other alternative is seemingly presented than considering the matters thus suggested from the standpoint of principle.

1. The doctrine of alternative injunctive relief, as expounded by this court in *New York City v. Pine, supra*, has apparently been recognized as establishing a substantive principle by certain of the text writers, as well as in various decisions in the lower federal courts.

See *Western Union Telegraph Co. v. Georgia, etc. Co.*, 227 Fed. 291.

Kamper v. Chicago, 215 Fed. 708.

Eastern, etc. Land Co. v. Des Chutes R. R. Co., 213 Fed. 900.

Bannse v. N. P. Ry., 205 Fed. 330.

Cubbins v. Mississippi River Commission, 204 Fed. 304.

Hagerla v. Mississippi, etc. Co., 202 Fed. 783.

See also, *Vol. 2 Beach Mod. Eq. Jur.* 727.

Whatever may be said for the rule as thus applied by the lower courts, as announced by this court in *New York City v. Pine, supra,* it cannot be separated from the particular circumstances of that case which gave rise to its application. These circumstances involved features of the complainant's good faith, which, while not constituting a technical estoppel, were not without influence in an appeal to equity for provisional injunctive relief. There was similarly presented, features of *laches* to which express reference was made and which for obvious reasons had material bearing on the right to equitable relief.

The decision in this case must seemingly, therefore, be regarded as *sui generis*, and referrable to its own perculiar facts, rather than as one stating a settled rule of indiscriminate application.

The principle, to which this assumed rule is referrable, is one which emphasizes the discretionary character of injunctive relief in general. Its results seem, however, to have proceeded from the conception of the rights involved in proceedings of eminent domain, which presuppose the right of taking *in invitum.*

This last can have no application in the case at bar for the quite obvious reason that a right, on the part of Minnesota, to acquire property by eminent domain in complainant state, is inconceivable.

Were it to be held in this case complainant was not entitled to the ordinary and appropriate relief by injunction, restraining future repetitions of the trespass on its

domain, except on condition that Minnesota declines to pay a sum or award fixed by this court for the privilege of continuing that trespass, the result would be tantamount to establishing a right of condemnation by one state, of property in another, without the latter's consent.

Commenting on the general subject thus suggested, Mr. Farnum employs the following terse sentence:

> "There is no rule of law which will permit one man to take possession of another's property, and then force him to accept damages in lieu of a right to recover the possession of it."
>
> *Vol. 2, Farnum, Waters and Water Rights*, p. 1870.

Whatever reason may be assigned therefore, for this assumed rule of alternative injunctive relief, it is not conceived it can or should be extended to cases involving conflicting interests between States.

2. With respect to the remaining questions above suggested, complainant's conclusions may be thus succinctly stated.

(a) While the rule and measure of damages, adopted in cases where private interests are concerned, may appear both unreasonable and inadequate for determining the redress to which a state is entitled for trespass on its domain, there is no other known rule to which recourse may be had. It is necessarily assumed that the general theory of compensatory damage will be applied and as the principles, upon which that damage is ascertained, have long been settled, they are as applicable, in a suit between States, as in one between private individuals.

While making this concession from seeing necessity, the complainant does not concede either the propriety or reasonableness of the rule thus indicated. It goes without saying that its technical limitations would not be re-

garded as controlling in diplomatic negotiations. If an extreme illustration were supposed of the people of a state being driven therefrom by force and on restoration to possession, limited to an indemnity equal to a rental value of the lands of which they had been deprived, the absurdity of the resultant situation is apparent.

Without other criteria, however, complainant is, perforce, compelled to accept, by analogy, the ordinary established rule, in cases between private litigants.

(b) It is further assumed that in their essential features, the rule or measure of damages established at law in analogous cases are determinative in equity.

While distinctions are suggested in some of the cases as to the rules governing in legal and equitable proceedings, the differences are of relatively slight importance so far as this case is concerned.

See however, *Stowers v. Gilbert*, 156 N. Y. 600.

(c) The local rules prevailing in the states involved, are not controlling, except upon the hypothesis of the court's assuming, in a particular case, that justice would be accomplished by assessing against defendant a measure of damages which it, itself, had established as governing in similar cases. Independently of the exception just noted, the rule must be established with reference to the common law, in the interpretation of which this Court is not governed by local decisions.

(d) It is generally held that where the agency through which a trespass is committed is permanent in character and such as to necessarily presuppose a continuance or repetition of the wrong, that the injured party has the option of treating the damage as permanent and as such, to be recovered in a single action, or, to have recourse to successive actions.

See Vol. 2, *Farnum, Waters and Water Rights*, Sec. 589 and cases.

Vol. 4, *Sutherland on Damages* (3rd ed.) p. 3034.

Bowers v. Mississippi, etc., Boom Co., 78 Minn. 398.

Hueston v. Mississippi, etc., Boom Co., 76 Minn. 251.

See also *Note to Irvine v. Oelwein*, L. R. A. (N. S.) 1916 E, p. 1068.

The form of the proceeding necessarily determines which option has been exercised and whatever doubt might exist in an action at law, owing to the ambiguity in which a complaint was couched or otherwise, no such doubt can exist in a suit in equity, the objective purpose of which is to obtain an abatement of the nuisance, thus precluding the idea of permanency.

By analogy therefore to the rules obtaining in common law actions, where permanent damage is not asserted, the damages are to be assessed up to the time of the commencement of the proceeding.

See authorities last above.

(e) Vol. 2, *Farnum Waters* at sections 589b, 589c, 589d and 589e reviews the rules obtaining in common law actions for determining damages in cases of this class. These, for all purposes of the present case may be briefly stated as follows:

First: Compensation for property actually lost or destroyed as the immediate result of the trespass, including herein, crops growing on the land at the time of the trespass and also including improvements.

Second: Actual damage to the land itself, measured by the cost of restoring it to its former state.

Third: The value of the loss of user, during the time

possession was withheld, as a result of the trespass, measured by the reasonable rental value thereof.

Fourth: Certain of the authorities sustain the rule that in lieu of rental value, the proprietor is entitled to recover the impairment in value, resulting from the trespass, measured by the assumed difference between the land immediately before and immediately after the trespass.

This rule has seeming approval in the Minnesota decisions in *Hueston v. Mississippi, etc. Boom Co.*, 76 Minn. 251; *Bowers v. same*, 78 Minn. 398; *Osborne v. same*, 95 Minn. 149 and *Mandery v. same*, 105 Minn. 3, where the facts involved the unlawful flowage of lands, as a result of structures erected by the defendant in the river and where in each instance the case was held controlled by the rules of "continuing trespass" in which the damage was to be assessed to the date of the action and it was held the measure of such damage was the difference between the value of the land immediately before and immediately after the flooding.

Consideration of the Damages Established by the Evidence.

It is unnecessary to review the evidence on this branch of the case in detail. This for the reason, amongst others, it is quite possible the subject may be referred by the Court to a Master for determination. It will suffice for immediate purposes therefore, to state that the evidence, offered by complainant, was addressed at establishing the several elements of damage last above indicated.

This evidence followed substantially the same lines with

all of the witnesses produced, as will sufficiently appear from the following:

1. *The Crop Loss:* This was established by showing the condition and general character of the crops in the area involved, which were destroyed in 1915 by the floods; the average yield, as determined by other portions of the same land not flooded, as well as lands in the immediate vicinity and subject to the same general conditions; the cost and expense incident to harvesting and marketing and the market value of the product.

2. *The Loss of Improvements:* These last included the loss and destruction of miscellaneous improvements on the lands such as fences, roads, etc., etc., and the cost of restoration.

3. *The Expense of Restoring the Lands:* This included the miscellaneous expense of removing acquatic grasses, rushes, cattails, etc., with which the lands were grown up as a result of the flood and other features incident to plowing under the accumulation of mud and silt.

4. *The Rental Value:* In 1916 and 1917, as already stated, the lands, as a result of the flood, wene rendered practically useless for cropping purposes. During these two years therefore the evidence was directed at showing the rental value.

The evidence disclosed that farm lands in this region are rented almost exclusively on what is termed the "crop plan," that is, the proprietor receives his rental in proportion to the crop raised. For this purpose the character, quality and value of the crop raised on the uninundated portion of the lands involved and those in the immediate vicinity were established, as furnishing the only criteria on which the crop rental value could be ascertained in the years last stated.

5. *Impairment of Value:* Substantially all of the witnesses testified that the existence of the floods was practically destructive of the market value of the lands. The questions propounded in this regard presupposed the contingency of a repetition, or liability to repetition, of the flood condition and may thus be assumed to have had reference to permanent damage, which, for reasons already stated, is not regarded as pertinent to the issues here presented.

6. *Public Damage:* This included the damage in which the State was immediately interested, including the injury to roads, bridges, culverts, etc., and was established by the necessary cost of restoration, and loss of revenue, due to abatement of taxes by reason of the floods.

A summary of the evidence with the amount of damages disclosed appears in the accompanying tabulated statement with references to the record.

Name of Owner	No Acres	1915 Crop and Improvement Loss	1916-17 Rental Loss	Re
Charles R. Pinkey	450	$8897.50	$6865.00	$
John H. Bolton	150	2275.50	1097.75	
Wallace J. Taylor	140	1654.00	1055.00	
Earl Burgess	160	1449.95	1308.00	
Andrew Rydell	160	3680.65	2301.34	
Joseph W. Gajer	525	3916.25	6150.23	
Peter G. Smith	120	1771.50	875.15	
John C. Hurdelbrink	140	975.82	1001.37	
Albert L. Waddington	200	1885.00	1620.50	
Mary E. Clarey	452	5251.00	4617.15	
Herman G. Miller	165	1152.50	2602.30	
J. A. Ennis	154	1300.30	1350.00	
*Grover Williams	154	1133.82		
Charles L. Baker	158	1505.60	1400.00	
John F. Broderick	240	720.00	1160.00	
John E. Bruns	130	1102.50	4557.75	
James A. Westerman	320	4562.00	4557.20	
D. B. Martin	175	2315.50	2536.00	
John Nagel	60		650.00	
Gustaf F. Lundberg	160	584.69	1000.00	
B. W. Schouweiler	160	2633.25		
Newell M. Powell	160	1649.00	1259.20	
Joseph A. Sauter	150	792.85	2666.79	
*Fritz Quidding	282	2961.75		
H. W. Briden	160	500.00	1000.00	
*E. N. Nelson	227		1815.00	
Burt Kurtz	40		660.70	
*Burt Kurtz	221	910.00		
Ole Swivel estate	221	525.00		
Orville C. Andrews	240	1627.20	1174.10	
	6074	$65492.93	$51908.53	$23

*Tenant.

As shown on this statement, the crop and improvement loss during the year 1915 aggregated $65,492.93; the loss for the years 1916 and 1917, estimated on the rental value, $51,908.53 and the cost of restoration of the property, $23,140.00.

The total of the three items last mentioned constitute the damages disclosed by the proofs, as computed by application of the common law rules, already considered.

The item of impairment in market value is $293,682.50. This is reached by application of the alternative rule sustained by some of the authorities, including the Minnesota cases already cited, which measures the damages in such cases at the difference between the market value before and after the trespass.

In presenting its evidence on this feature of the case, complainant, as stated above, has endeavored to conform to the rules of the common law. The alternatives in the proofs have been adopted in deference to what appears to be a difference of opinion, as to the manner in which the damage should be ascertained.

Neither rule, in the opinion of complainant, affords just compensation for a damage of the character here involved. Both have proceeded from the difficulties conceived by the common law judges in their endeavor to establish a principle broadly applicable to all cases in general. In recognizing these rules in its proofs, even while disapproving them in principle, complainant will at least have established that it has not sought to make the present proceeding a vehicle for mulcting the defendant.

With the elements thus presented, sufficient is believed to have been disclosed to enable the decree to fix just compensation for the injuries sustained.

In addition to the matters thus referred to, there is the matter of the public damage in the destruction of roads, bridges, culverts and miscellaneous improvements in the flooded area aggregating $7,280. (Rec. 1807 and 1809) and a negligible item of loss of taxes by abatement (Rec. 1657, 1658) which needs not be considered.

CONCLUSION.

The vital importance of the questions at stake between the respective States, parties to this controversy, must furnish the apology for the length of this brief. In a motion heretofore preferred to the Court with respect to the printing of the record, it was asserted by complainant that the proceedings had been unnecessarily cumbered by Minnesota, in various ways not necessary to be here again alluded to. We think the Court cannot fail to be impressed with the justification of these criticisms on the methods which have been pursued by Minnesota in the various preliminary proceedings in this cause. The wholly unnecessary prolixity of the evidence, with the variety of contentions advanced in Minnesota's behalf, has seemingly left no other alternative, than that herein adopted, with respect to the presentation of the case.

In following out this method of presentation, it has been the aim of counsel for complainant to aid the Court as far as possible, in its review of the matters here presented. If the methods thus adopted have failed in this latter respect, it must be attributed to counsel's misfortune rather than their fault. Upon consideration of the merits, it is believed that complainant has shown a case clearly entitling it to the relief here sought, including

an injunction restraining further repetitions of the trespass on its domain and damages for the injuries already sustained.

Respectfully submitted,

THE STATE OF NORTH DAKOTA,
Complainant,
By WILLIAM LANGER,
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ABSTRACT OF COMPLAINANT'S EVIDENCE ON REBUTTAL.

FRANCIS C. SHENEHON: As previously stated I have been over the ground in the Bois de Sioux Valley and observed the East and West roads crossing the Valley to which reference has been made by the witnesses of defendant and which are claimed to have been partly responsible for the flood conditions. From an engineering standpoint, aside from the White Rock road, none of these roads would be an impediment or cause the raising of the water more than a fraction of an inch. So far as the flood conditions with which we are dealing are concerned, these roads are negligible. Rec. 2066 (3392).

The fact testified to by Prof. Bass that Lake Traverse reached a level of 976.61 in April, 1916 and substantially the same level in 1881, has, in my opinion, no bearing on the matter with which we are dealing. In 1916 the high level was continued over a considerable period. We know nothing of this condition as respects 1881. The high level then recorded might have been due to what is known as the seiche, the swing of the water, which might raise it to the point indicated for a half an hour. This is very common in lakes. The seiche is a form of wave that swings back and forth across the lakes. Rec. *id.* (3393).

If the condition in 1881 with respect to rainfall were the same as in 1916, my judgment is that had the artificial ditch conditions then existed, the lake would have been still higher. Rec. 2067 (3394).

Prof. Bass' assumption that the discharge of the Bois de Sioux at the Great Northern bridge near Fairmount was 2000 second feet is based on an assumed surface level at the bridge, of 969 and a velocity of 2.7 feet. This assumes the water was up 1½ feet higher than the levels used in our computations of 967.5. Rec. *id.*

Based on the latter and assuming the velocity of 2.7, the discharge is 1450 second feet. Rec. *id.*

In Prof. Bass' testimony, he assumed the discharge capacity of the original channel round the bend at 1500 second feet and that of the cut-off at 1,000 feet. The velocity of the channel was taken at 1.6 feet and the cut-off as 2.4 feet. The cross sectional area of the cut-off as 400 feet. The average fall of the cut-off was assumed at 2.1 feet to the mile but emphasis was laid on the variation of the bottom level of the latter at different points and

even a negative gradient at certain points. If the negative gradient existed, the flow would not be increased by filling up the upper end so there would be a slope. In my opinion the capacity of the cut-off exceeds that of the original channel. Rec. 2068 (3395).

Considering the tortuous channel of the river and the direct channel of the cut-off, if a velocity of 1.6 feet is to be assumed for the former, a velocity of 2.4 feet for the latter is absurd. Rec. *id.* (3396).

This, for the reason the elevation of the water surface at the up-stream end of the cut-off and river and the down-stream end of the same are substantially identical. Mr. Bass assumes that the fall is 5 feet. Hence, the slope is only one-third as great in the channel as in the cut-off, or, otherwise expressed, the slope of the cut-off per mile is three times that of the channel. All other conditions be ing equal, the velocity of the cut-off would be 73% in excess of the channel but the other conditions are not equal. The cut-off is a clean prism flowing straight away excepting the curvature at the lower end. The cut-off is favorable for flow. The co-efficient of flow is high. The channel, on the other hand, is meandering. I figured it out that in its six or seven miles, the turns amounted to 6 complete circles. Its cross section varies. It is obstructed by weeds and growths. The velocity is evidently so slow that these are not removed even in flood. These features indicate the excess volume of the cut-off. Rec. *id.* (3396-7).

There are no complicated engineering factors presented by the physical conditions in determining the relative capacity of the cut-off and channel. My opinion is that the velocity of the cut-off was between 4½ and 5 second feet. Rec. 2069 (3397).

The depth of the water is a material factor in determining velocity. The general hydraulic relations between depth and velocity is that velocity varies as three halves power of the depth. Rec. *id.*

As to Prof. Bass' claim that the channel would open earlier than the cut-off and that generally an East and west channel is less affected by the sun than one running north and south, he has simply confused directions. The converse, in my opinion, is true. Rec. *id.* (3398).

The claim of obstruction by ice at the peak of the flood is something I cannot comprehend. Ice is lighter than wa-

ter. I cannot conceive that it can be so tightly frozen to a glacial drift bottom that it can't come up when the water comes along. Nothing in the conditions there suggest any appreciable difference between the opening of the cut-off and the channel. It appears to me that in a number of these matters Prof. Bass has grasped at straws. Flood conditions depend on the length of time during which the high stages of water continue. There may be a considerable period during which the water is rising to the peak and also during which it is receding. Rec. *id.* (3399) 2070.

So far as the readings of the water levels n the vicinity of Wheaton in the year 1916 and 1917 following the flood are concerned, the former have some relevancy. The gauge read very much lower at this time, but we can project the discharge somewhat roughly to the higher stage to estimate the flow during the 1916 flood period. The readings are only valuable for comparative purposes. Rec. 2070 (3399).

The controlling question with reference to these flood conditions is that the volume of water reaching the lake was much in excess of the volume that would have reached it in the same period in a state of nature. Rec. *id.* (3400).

As to the testimony of Prof. Bass and Prof. Sardeson to the effect that 12 Mile Creek cuts the ditch substantially at right-angles and that the main flow follows the original channel, this, in my opinion, is another case of grasping at a straw. According to my computations, the added flow in the natural channel due to this condition might be 1% or 10 or 15 cubic feet. This is one of the little things therefore that needs not be considered. From an engineering standpoint, the circumstance that the ditch was cut at right angles would have a very trivial effect on the flow. You convert the velocity in a particular direction into additional head. This, as I compute it, would be about ¾ of an inch so that the total slope in the channel would be 5 feet and ¾ of an inch instead of 5 feet, thus, as stated, increasing the volume approximately 1%. Rec. 2071 (3401).

There is nothing to the claim that the construction of the ditch at right angles would have any damming effect. Rec. *id.*

Taking the reading at Wheaton, for example, in July, 1916, Prof. Bass claimed that the excess flow over the

1500 second feet capacity, estimated for the original channel, would be about 50 second feet and that this would account for raising the waters of the lake about 2 inches. I think these conclusions are erroneous. The water presented at the junction of the loop and cut-off is greater under the artificial conditions than in a state of nature. The cut-off takes the water before the loop. Rec. *id.* (3402).

The figures assuming the natural flow around the loop and the excess over this amount at the point of discharge, establish nothing from an engineering standpoint in this case. Rec. *id.*

Prof. Bass' claim that the time of flow from the upper end of the cut-off to the lake through the original channel would be 18 hours and through the cut-off 9 hours, shows the higher velocity under artificial conditions, but does not include the element of volume and loses sight of the element of that part of the water that would have lain on the prairies and evaporated. These waters come down under the new artificial conditions. They did not get down in a state of nature. Rec. 2072 (3403).

There is nothing to the claim of Prof. Bass to the effect that the ditches will cease to function when they are overflowed. The ditches will function as long as there is any gradient in the direction of the ditch. Rec. *id.*

A similar situation is presented in the Valley of the Bois de Sioux. When the lands are submerged, the natural channel is submerged but it still goes on functioning. Rec. *id.* (3403-4).

As to Prof. Bass' claim that the ditching of the main river channel beyond the cut-off had no appreciable effect, my judgment is that it undoubtedly lowered the flood plane and produced a higher discharge capacity for the loop. It permitted the water to flow more rapidly toward the Lake as indicated by Prof. Bass' own computation of time. If the cut-off had been built without dredging the river channel, the former would have had a smaller flow capacity. Rec. *id.* (3404).

CROSS EXAMINATION.

I still give my adherence to my previous statements relating to the detaining basin above the cut-off. Rec. 2073 (3404).

I am not assuming the so-called Delta Zone as a Lake. I merely regard it as an area where the surface water was

on an incline corresponding to the surface of the ground and where its depth might have been one-half an inch or more. This surface water moves at an exceedingly slow pace until it reaches the confluence near the ditch where flooding conditions manifested themselves. This whole detaining basin was covered by the mesh-work of ditches which were made effective by the cut-off. I think I also stated that evaporation over such an area where the water might be a quarter of an inch deep would be greater than though it were 2 feet deep and that much of this water in a state of nature would evaporate and never reach the main streams. Rec. *id.* (3405-6).

I am not precise as to the depth of water, within this area. I think the area itself is coextensive with that covered by the artificial ditch construction. Rec. 2074 (3406).

I include any area tributary to the artificial condition created prior to 1916. That is, the area where there has been an attempt by the engineers of Minnesota to get rid of water. I assume this attempt was not an entire failure and that they succeeded in bringing down much more water than came in a state of nature and more rapidly. The gradient of the country involving hundreds of square miles disclosed that there must have been considerable flow in the ditches. Also, that this flow brought water to the cut-out and main channel that would not have been brought in a state of nature and brought that which would have reached the outlet in a state of nature much more rapidly, thus producing flood conditions. I have no doubt that the farms in this area raised some crops and they doubtless had pasturage and meadow lands. Rec. 2074 (3407-8).

If you assume the water remaining upon these lands was not sufficient to prevent their use for agricultural purposes, I should still adhere to the opinion that the waters flowing from them in 1915 and '16 were sufficient to account for the floods in question. The reference to this Delta Zone as an overflowed area is confusing. The water comes from the heavens in the form of rain or snow. Water which was never brought down before; that would have lain in the ground was brought down by this artificial construction and waters that might have been brought down in a natural state were brought down more rapidly. (Rec. 2075 (3408-9).

My conclusions with reference to this Delta Zone and

its effect are not based on Mr. Ralph's testimony. I have formed my independent conclusions from my study of the situation on the ground and have stated them as clearly as I could. I have not based my assumptions on the descriptions of Mr. Ralph of the conditions before the ditches were constructed. There is not the slightest doubt in a state of nature there was considerable flooding at the confluence. The depth of that flooding or the area is not the controlling question. It would make the land untillable while it continued. These ditches with their various laterals including the cut-off and the rectified river which made the system effective were constructed to obviate those conditions. Rec. 2076 (3410-11).

A flood is the precipitation within a short time of water that would otherwise lie on the ground and evaporate. Evaporation will take from 3 to 5 inches in a month but the ditches will take water much more rapidly and in greater volume. Rec. 2077 (3412).

Some of the lands within the general area in question would necessarily be swampy, the proportion I don't know. The plat of the government survey (Exhibit 112) gives no topographical indication of marshy land. Exhibit 112 was the government plat of Clifton Twp. 113-Logan Twp. and 114 Gorton Twp. The same is true so far as any indications on those are concerned. On Exhibit 115 (Redpath Twp.) several square miles are indicated as marshy land. If there were no more marsh lands in the Delta Zone than those indicated on these several Exhibits, it would not qualify my opinion. Those are evidently permanent marshes, as opposed to a detaining basin operative in the Spring and at other times of excessive rainfall. Rec. 2077-78.

My opinion assumes that not only much more water was drained off these lands under the artificial conditions but also that it was drained in a shorter time than in a state of nature. Rec. 2079 (3415).

If the precipitation and other natural conditions were the same, it would necessarily follow that after the construction of the ditches, there would be less flooding than in previous years. As to the assumed claim by the residents of the Delta Zone that from 1887 to 1914 there was no loss of crops from excessive water in its bearing on my opinion, these lands received the natural precipitation and had constructed on them a transportation system to

remove the water. I can only conclude this system acted with respect to the water. As to the claim that these ditches running down hill and including the cut-off and the rectified water did not serve to carry away the water, I should say that all the laws and all the common sense relating to the flow of water has some how or other been emasculated. As to the claim that these ditches did not carry away the water from the Delta Zone in 1914-'15 and '16 and that they had the first crop failures during those years since 1887, I have seen the evidence of the volume of water that went down the river; know the measurements at Wheaton and know the volume from the height of the River at Wheaton. I conceive the ditch system did carry down great quantities of water. Rec. *id.* (3415-16).

I think the rainfall in 1915 and '16 caused the overflow of these lands and accounts for a sufficient excess going down the river that would not have gone down under a state of nature to cause the flood conditions; also, that this is true in lesser degree in 191[illegible] Rec. 2080 (3417).

The slope of the land in this area is toward the confluence of the rivers at the cut-off. It is about 1⅛ inches in 100 feet. It then follows the course of the River south and southwest. In the vicinity of Norcross the slope is slightly to the northwest following the trend of 12 Mile Creek. The trend of 12 Mile Creek is north, slightly to the west. The flowing water will follow the line of least resistance. Gravity, of course, is the controlling feature except as the surface slope is cut by ditches. If the ditches intercept the flow and have a gradient either on the bottom or on the surface of the water which they carry, there will, of course, be a flow in them. The fact that the trend of the ground is slightly westward did not prevent the flow of the water due north in 12 Mile Creek. Rec. 2080 (3417-18).

From the G. N. Ry. near Norcross, the slope is almost west until the point is reached where the main River channel turns south to the Lake. Rec. 2081 (3418).

As to the testimony of the residents to the effect that in 1914-'15 and '16 more water flowed directly North into the Tintah Slough and Rabbit River, than they had ever observed before, my opinion reached by going over the ground is that no considerable amount of water flowed overland into the Rabbit River I examined these condi-

tions carefully with a view to finding the evidences of any considerable flow toward the Rabbit. I examined the flood channels very carefully and was unable to discover any evidence of any considerable flow to that River. There were indications that at flood times there was a limited flow in this direction. Rec. *id.* (3419).

I did not find any evidence that any considerable flow toward the Rabbit was diverted by the construction of the state ditch. Rec. *id.* (3420).

I do not credit as a fact the claim that notwithstanding the construction of the ditch there was a large flow into Rabbit in the years stated. I assume that less water passed in to the Rabbit than would have passed in a state of nature during those years. Rec. 2082 (3421).

As to the claim that in 1881 the high stage in Lake Traverse continued for over two weeks and then gradually receded until the Fall, if the channel conditions in the Bois de Sioux River were the same, I see no reason why the same quantity of water should not be discharged from the Lake. Whether the Rabbit River conditions were such as to combine with the flow of the Lake, I have no means of knowing and I am unable therefore to determine as to the flood conditions in the Bois de Sioux at that time. Rec. 2083 (3422).

As to the testimony that in the Spring of 1897 the Lake reached the same level as in 1915 during the flood, if this, as stated, was on the first of April, the Lake elevation might be due to channel obstructions, as by ice, in the Bois de Sioux—ice jams such as occur in the Mississippi and are at present blocking the Ohio River. Rec. *id.* (3423).

I give no credit to the testimony that in 1881, 1897 and 1916 the flow from the Rabbit River as its mouth was such as to turn the entire current of the Bois de Sioux to the southward. In my judgment this is a physical impossibility with an unobstructed channel from Lake Traverse and the volume of water flowing at the stage to which the Lake had then risen. Rec. *id.*

I can conceive that under such conditions there would be some possible backward flow but this would make no difference, in my opinion, with respect to the cause of the floods in the Bois de Sioux Valley. Rec. 2084 (3424).

As to the claim that the Rabbit River when running bank full is the dominant stream, that represents a state

of nature and I am superimposing upon the state of nature, whatever it may be, these other artificial conditions which created the floods. Rec. *id.*

As to the effect of the ditching into the Rabbit, I adhere to my original opinion that it was practically offset by the lessened flow into that River due to the ditching of the Mustinka so that the Rabbit remains substantially as in its natural state. Rec. *id.* (3425).

As to my statement that Prof. Bass' estimate of 2.4 second feet for the velocity of the cut-off was absurdly low, I assumed that he meant the average velocity with the ditch flowing at capacity. Rec. 2085.

My estimate of the velocity of the cut-off was from 4½ to 5 second feet. I reached this conclusion as follows: The fall between the head and foot of the cut-off is the same as that around the loop. This, Prof. Bass assumed, was 5½ feet on the water surface. One of the laws of the fall of water is that the velocity, other things being equal, will vary as the square root of the fall between two points. As the loop is three times the length of the cut-off, the fall per mile of the latter is three times that of the former. I judged the velocity due from this alone is 73% in favor of the cut-off. The other conditions such as curvature of the natural channel; the obstructions by curve therein, the variance in its cross-sectional areas at different points, etc., render it less effective by half, than the cut-off. The cross section area of the channel is stated at from 600 to 800 square feet. And that of the cut-off as 400. Taking the larger cross sectional area for the former, the relative capacity of the cut-off is 25% in excess of the channel. The projections of the geological survey curve at Wheaton, indicate a flow of about 3000 second feet. This is confirmed by the contribution that would be made from the system of ditch construction. Thus, if we figure a contribution of 5 second feet per square mile, it would give us 3500 second feet as the flow at the cut-off in the ditch region. Mr. John T. Stewart in Bulletin No. 189 of the Department of Agriculture, indicates the drainage co-efficient used in computing the sizes of the ditches and that we must count upon a discharge of 4.45 second feet per square mile. He also quotes on Page 24, J. P. Fanning, a distinguished Hydraulic Engineer in Minnesota. Col. Fanning's estimate of the flood run-off in the Red River Valley is 6.36 second feet

per square mile. I base my figures on an estimated area of between 600 and 800 square miles. Using Prof. Stewart's value of 4.45 and 700 sq. miles, the results would show for the cut-off, 3115 second feet. Using Col. Fanning's value of 6.36 which I assume is for extreme floods and the same area, would indicate 4452 second feet. The projection of the geological survey curve, indicating a discharge of 3000 second feet in 1916 at Wheaton, appears reasonable. The bulk of this comes through the cut-off and the channel. Taking Prof. Bass' estimate of 1500 second feet for the latter, the capacity of the cut-off would be about 1870 feet. In my original testimony, I placed the capacity at between 1800 and 2000 second feet which would correspond to a cross sectional area of 400 square feet and a velocity of from 4½ to 5 second feet. The conclusion of velocity is further confirmed from my observations on the grounds. Rec. 2085-86.

I take the co-efficient of roughness in Kutter's formula as .022½; the hydraulic radius as 7.0; slope 2.112 to the mile which gives a velocity of 4.83. Taking the cross sectional area at 400 square feet, gives a discharge capacity of 1932 second feet and taking the cross sectional area of 360 square feet, gives 1740 second feet. Rec. 2086 (3428).

I examined the ditch in September of this year, measured the cross section area and convinced myself of the high water level. I, therefore, assume the statements I have made as to the relative carrying capacity of the channel and cut-off are substantially correct and that the aggregate flow being upwards of 3000 second feet, the carrying capacity of the cut-off is 1000 second feet in excess of Prof. Bass' statement. These computations view the matter from several angles which include taking an average slope from the head to the foot of the cut-off. Rec. 2087 (3429).

In making these figures I had those prepared by Mr. Nelson as testified by Prof. Bass. The difference between the latter and myself is in the method of computation. He divides the channel into sections with assumed surface levels and assumed slopes reaching the conclusion of 1,000 second feet as its carrying capacity. His average velocity is thus low as compared with what in my opinion the true velocity of the cut-off actually was. Rec. *id.* (3429-30).

The negative gradient which Prof. Bass emphasizes as existing on the bottom of the cut-off in the first 1800 feet is about .3 of a foot or about 4 inches in 1800 feet. The bottom therefore, is almost level. The gradient of the surface of the water must be down hill, that is, the grade of flow. Rec. 2087 (3430).

I attach no importance to the claim the River channel thawed out earlier in the Spring than the cut-off as bearing on the flooding of Lake Traverse and the Bois de Sioux. The testimony of the residents that the channel opens some two weeks before the cut-off could, in my opinion, only exists in the case of ice jams in the cut-off. Rec. 2088 (3430-31).

I assume the conditions of the original channel with respect to grass and weeds as I observed it. In September when I inspected it, there was no flow in the channel, but a small flow, probably 10 or 15 second feet in the cut-off. I examined it also in May, June and July. I might add that my conclusion as to the physical conditions of the channel correspond with Prof. Bass as we have each used the same natural co-efficient in applying Kutter's formula. I used a higher co-efficient, viz: .022½ in figuring the cut-off where I understand Prof Bass used .028. I used the same co-efficient as Prof. Bass for the channel, viz: .35. I assumed 1500 feet for the channel as an adjusted value. Mr. Ralph's figures, I think, were 1848 feet. The conditions are so complex I doubt if this could be accurately figured. Rec. 2088 (3431-33).

It is not true that the only water which would flow into the Lake on account of the cut-off was what was taken by the cut-off in excess of what would have followed the channel in a state of nature because the capacity of the channel has been increased by the rectification of the River below. This, because of the greater slope. By lowering the level at the lower end, the slope of the channel is increased with a consequent higher flowage capacity. Rec. 2089 (3433-34).

This is a small factor. There would be a slight retardation owing to the influx of water from the cut-off. At the lower end of the loop, the River has cut into the original mud about two feet which discloses high velocity there of late years. As to the dominant channel, I have already expressed my opinion that the capacity of the cut-off is about 25% in excess of the channel. Hence, if the domin-

ant stream is one of greatest flow, it is the cut-off. Rec. 2090 (3434).

The cut-off as the dominant stream would have some effect on the flow of the channel at the point of confluence. I do not think the additional flow in the channel is of sufficient importance to place any weight on it, that is, that the carrying capacity of the channel is about the same now as in the natural state. Rec. *id.* (3435).

The discharge through the two channels, that is, the cut-off and loop, would be the sum total of the volume coming from above. If 1500 second feet would pass through the channel, it would pass whether the cut-off were there or not. The increase in the water flowing into Lake Traverse would be determined by ascertaining the amount in which the maximum discharge at Wheaton exceeded the natural channel capacity in time of maximum flow. Rec. *id.* (3435-36).

The figures quoted from Mr. Fanning are the volume of flood run-off of the Red River Valley employed by him in designating the capacity of ditches. Rec. 2091 (3436).

The maximum run-off per square mile from the Bois de Sioux River is less than one second foot, but this is due to the action of Lake Traverse as a detaining basin which diminishes the flood run-off. If the Lake were absent, it would be about 5 sec. feet. I have assumed for the carrying capacity of the loop, as stated above, the value indicated by Prof. Bass. Rec. *id.*

RE-DIRECT EXAMINATION.

My figures with reference to the discharge of the Bois de Sioux were given with reference to the high bridge about two miles north of Fairmount. I think the elevation of 969 given by Prof. Bass refers to the G. N. bridge further up stream. The discharge of 2000 feet as given by him at that point is about 450 feet in excess of my figures. Rec. 2092 (3438).

RE-CROSS EXAMINATION.

My figure of 967.5 as the elevation at the high bridge is not an assumption. It is the crest line of the flood indicated on the piers of the bridge. These were observed on my visit in May and again in June this year. They are clearly marked. This is corroborated by other drift observations which I made. Prof. Bass and myself agree fairly as to the discharge at the outlet of Lake Traverse but I am unable to understand the figures he reaches at the G. N. bridge. Rec. 2092 (3438-39).

W. R. POWRIE: I am one of the engineers of maintenance of the C. M. & St. P. Ry. I have been four years in that position at Mpls. Previously I was in Milwaukee and on the Coast Line. I was in my present position in the spring of 1916. My division includes the line which crosses the Mustinka at the point in question. (3319).

I was on the ground during the high water of 1916 on March 30th and observed the stage of the water. On that day it was 3 inches below the caps on the piles of the bridge. That is the bridge which is still there. Rec. 2092-93.

CROSS EXAMINATION.

I have been with the Milwaukee as an engineer for 20 years but have only been in this territory since 1913. Rec. 2094 (3441).

I am unable to say whether the water was up to that height later in the season but don't think it was. The water was up there for a while. I don't think it was up to the high water mark for very many days but cannot tell you how many. Rec. *id.* (3442).

The water was damned to some extent probably for a mile or more north of the bridge. It broke through at one place and washed out about 500 feet of track. I do not know how long the high water conditions remained. The elevation was about the same at the River and north of the track. Rec. *id.*

The wash-out was about 1800 feet north of the bridge. The track at this point runs about north and south and the River east and west. All the territory north of the River was under water as far as I could see to the east. I think I can say that we had not had this trouble previously. Had there been any trouble with the track, I would have known it. (Rec. 2095 (3443-44).

CROSS EXAMINATION.

At the time I observed the water level at our bridge, as stated, I also observed it at the wagon bridge there. It was over the floor of the bridge. Rec. 2096 (3445).

E. F. CHANDLER: I have computed the discharge of the Bois de Sioux River at the highest flood stage as having an average velocity of 2 sec. feet. This makes the total discharge 1400 sec. feet. (Rec. 2096 (3446).

Referring to Prof. Bass' testimony as to the relative discharge capacity of the channel and the cut-off and that the velocity of the latter was 2.4 feet, my computations

for the velocity of the cut-off at flood stage shows about 3 times that of the channel. Rec. *id.*

I have made the computations both by comparison and by Kutter's formula with similar results of ascertaining the velocity of the cut-off between 4½ and 5 sec. feet. Rec. *id.* (3447).

As to the relative carrying capacity, my figures show that of the cut-off between 1600 and 2000 sec. ft. and that of the channl between 1000 and 1500 sec. feet. The latter depending to some extent, on the assumptions as to coefficients. In either case, the cut-off capacity is approximately 1½ that of the channel. Rec. 2097 (3447).

In determining discharge capacity, the water levels are important factors. Rec. *id.*

The method employed by Prof. Bass of starting with an assumed elevation at the confluence of 12 Mile Creek and the River and running back a gradient to the confluence of the creek with the cut-off, is largely arbitrary. If no evidence were obtainable as to the actual height of the water, there would be no other basis on which to make assumptions. Rec. *id.*

I assume for the water level at the cut-off and 12 Mile Creek an elevation which gives the water through the cut-off a depth of from 10 to 12 feet. The two feet allowing for irregularities on the bottom. Rec. *id.* (3448).

The only effect of the negative gradient in the cut-off on which so much emphasis has been laid is in reducing at some point the effective depth of the water about one foot. Rec. *id.*

If the reduction had been one foot in depth through the whole cut-off, it would reduce the velocity approximately 5%. If this reduction in depth was limited to sections of the cut-off, the reduction in velocity would be less than 5%. Rec. *id.* (3448-49).

With reference to the claim the original channel opens earlier than the cut-off, it may be stated that in any two parallel streams, they seldom open at the same time. In this case, with the tortuous channel, there is more chance for an ice jam. The cut-off is straight and the water has a straight shoot. The sunlight in this latitude at the end of March would fall into the bottom of an east and west channel from sunrise until sunset; with a north and south channel, the bottom would be in the shade in the morning and evening. Rec. 2098 (3449).

Prof. Bass reference to streets where there are vertical walls appeard to me to be a slip. The north and south streets get the sunlight more than the east and west streets in the spring. Rec. *id.*

As to Prof. Bass' testimony to the effect that the excess of precipitation in 1915 and 1916 was about 25% above that of 1916 and 1917 and that assuming the capacity of the River channel was 1600 sec. ft. and that the readings at Wheaton show an excess of about 50 ft. over this, from which he claims that a liberal allowance from the increased precipitation would be 50%, my answer is this: In the first place, the allowance for excess run-off should be made as an increase in the total run-off, not an increase in some particular portion that overflowed at a given point; in the second place, a 25% increase in precipitation would cause much more than a 50% increase in the run-off. If all the rainfall reached the streams, the increase in run-off and precipitation would be the same but in this country, a small proportion of the precipitation reaches the streams, hence, the increase in run-off expressed in percentage is likely to be 5, 10 or even 20 times thepercentage of increased precipitation. Rec. *id.* (3450).

If any estimates are made by application of this liberal allowance in this case, whatever the percentage adopted may be, should be that percentage of 1500 sec. feet, not that pencentage of 50 sec. ft. Correctly figured, on these assumptions, the result would have shown an excess flow of 780 sec. ft. instead of 90 sec. ft. even if only a 50% increase were taken. Rec. *id.* 2099.

As to the testimony that an overflowed ditch will cease to function if the natural slope of the country is in the direction of the ditch, the fact that the ditch is more than full would have no effect whatever except to accelerate flow because of greater depth. If the slope of the country is slightly oblique, the ditch will carry as much water as though not overflowing. The overflow is that much extra. Rec. 2099 (3451).

CROSS EXAMINATION.

The assumption that the water in this case was running north and south or at right angles to the ditches does not correspond with the evidence I have heard. Taking the case of the original ditch, it is my impression that the natural slope did not vary more than 20 or 30 degrees from the direction of the ditch. If the natural slope

were north, I fail to see how the ditch could carry any water as it would have no fall. Rec. *id.* (3451-52).

With this variance of 30% in the slope of the land, if the ditch were overflowing, the water being assumed to be a foot above its banks, the ditch would carry more water than if it were not overflowed becase it would have the same fall per mile that it had in the absence of the overflow and a slightly greater depth. Rec. *id.*

The overflow water passing over the top of the ditch would have very small velocity. The velocity in the ditch would be many times that of the water on the surface. The retarding effect would not be great enough to off-set the increased velocity because of the greater depth. Rec. 2100 (3452).

As to the testimony that from the G. N. Ry. to the upper end of the original ditch the flood waters flowed almost northerly as disclosed by flood channels and that more water ran to the north in 1915-16 and 17 than ever before, I am unable to believe that the slope of the country is other than approximately in the direction of the ditch. I think this testimony must have been given under misaprehension as to the effect of wind storms. Rec. *Id.* (3453).

The ditch follows approximately the course of the river. Three miles west of the G. N. Ry. the course of the river is west, northwest, or a divergence of about 30 degrees from the ditch. Rec. *Id.* (3454).

The water overflowing the surface of the ditch would be going partially west, not directly across the ditch unless the river ran up hill. This condition would not retard the flow of the water in the ditch. I did not examine this area sufficienty to give figures concerning the channels. Rec. (3334).

As to the claim after the construction of the original ditch and cut-off the waters continued to flow northerly into the Rabbit River in as great velocity as before and that this should require qualifying the opinion that the ditches accounted for the floods in question, my reply is that if the ditch has given a better outlet and increased carrying capacity for the water courses, it has unquestionably intensified and aggravated the floods and increased the total of water brought down. Rec. 2101 (3455).

I am considering the area as a whole with all of the ditching construction. Rec. *Id.*

While the flow of 12 Mile Creek and 5 Mile Creek is northerly and most of these ditches run east and west, the result may be thus stated: Had it been the intention to construct ditches to carry off water with the greatest possible speed, they would have followed the slope of the ground. But, constructed as they are, they will bring the water faster than if there were no ditches there at all. Rec. *id.*

If the ditches had no fall whatsoever, they would act as reservoirs and hold the waters possibly for a longer time than if the waters were on the surface. Rec. *Id.* (3456).

The claim that more water stood on the land in the Delta Zone during 1915 and '16 than ever stood there before is accounted for by the cumulative excess rainfall of the years 1914-'15 and '16 which the Exhibits of the defendants shows was some 16 inches. In other words, the condition is explained by a succession of wet seasons. Rec. *Id.*

Having no definite information concerning the fall of the (local) ditches, I can make no assumptions with respect to the testimony that these ditches failed to carry the water. Rec. 2102 (3456).

Assuming the correctness of the testimony that in 1915-'16 and '17 the natural channel around the bend overflowed and that the same volume of water passed to the north and with as great velocity as it did previously to the construction of the cut-off, the fact could be explained on the supposition that the natural run off of the drainage area for that particular year or years was increased over the previous years. It may also be that the ditching above had brought more water to this point. It may be it was simply the result of excessive precipitation. Rec. *Id.* (3457).

I have not considered the claim that during the overflow around the bend, part of the water runs across country. Such conditions, if they existed would not account for the increased volume of water at the Wheaton bridge. If they had existed for years, they would not cause any increase now. They would account for part of the total flow but not for any part of the increase. Rec. *Id.* (3458).

My estimate of the channel capacity around the bend was from 1000 to 1500 second feet. Rec. 2103 (3458).

Assuming the capacity of 1500 feet, a somewhat accu-

rate estimate of the increased volume due to the cut-off at Wheaton could be determined by the excess volume at the latter point above 1500 feet, subject to this correction. That with the cut-off 1500 feet could could come down the cut-off and loop combined without raising to as great a height or overflowing the country as much as though it were all carried in the original channel. Rec. *Id.*

I figure the cut-off capacity at from 1600 to 2000 second feet. At the time of my original estimates, I think I assumed a uniform gradient for the bottom of the cut-off and uniform slope for the water surface reaching the result of 2000 feet. Later, on hearing there were irregularities in the gradient of the bottom, I reduced the figures to allow for the somewhat diminished cross section with the result of 1700 to 2000 feet. Rec. *Id.* (3459).

I took the average depth of the water in the cut-off at 12 feet for the reason that at all the points I measured it would have taken from 11½ to 13 feet to cause any overflow. Rec. *Id.* (3459), 2104.

My reason for stating that Prof. Bass' computations in figuring the increased run-off on account of the increase of 25% in precipitation was that he assumed first that this increase of precipitation would increase the run-off only 50%. This last is unreasonably small for the region in question. It is more likely to be from five to ten times the percentage of the increase in precipitation and possibly more. Rec. 2104 (3460).

Furthermore, Prof. Bass applied this 50% increase not to the run-off which he assumed to be 1550 second feet but merely to the 50 second feet which he terms the excess above the capacity of the old channnel. His 50% increase therefore was not applied to the run-off but merely to a small section of it. Rec. *Id.* (3460-61).

I understand what his purpose was in figuring as he did but the figures have nothing to do with run-off. The capacity of the channel at the cut-off and loop would be a controlling factor in the amount of water at the Wheaton bridge but not in the run-off. Rec. *Id.*

I base my statements on the relative relation between increased precipitation and increased run-off on the records that have been kept of the streams in this region for the past 15 or 20 years and the records of run-off as compared with those of precipitation by the Weather Bureau. I can give you illustrations at Grand Forks where the

records have been kept for 36 years. Rec. 2104 (3461) 2105 (*Id.*)

There are no continuous records for Wahpeton. Rec. 2105 (*Id.*)

As to my statement that the overflowing of a ditch does not affect its carrying capacity, the velocity of flow is governed by the hydraulic gradient, the hydraulic radius and the roughness of the channel's sides. Rec. *Id.* (3462).

The hydraulic gradient for the overflowed ditch would be approximately the same as though it were not overflowed for the reason the ditch itself would have the same slope as the water surface above the ditch. If the capacity of the ditch is exceeded, it is not necessarily that the outlet is insufficient or that the ditch itself is dammed but that the whole length of the ditch is insufficient. There will be the same slope down the length of the ditch as before. Rec. *Id.*

If the whole length of the ditch is overflowed so that the surface is slightly above that of the surrounding ground, the hydraulic gradient would be substantially the same as though the surface were a foot below the level of the ground. Rec. *Id.*

The overflow of the ditch is due to the fact its hydraulic gradient is insufficient to take the water away. Rec. 2106 (3463).

Whether the point of minimum capacity in comparison with the water entering comes at the outlet or further up stream would depend upon the point where the water enters. If the ditch has a uniform cross section for a mile or more, as is often the case, this point would probably be near the lower end. Rec. *Id.*

Different interpretations may be placed on the description of a ditch as overflowed. If the whole surrounding country is inundated, thus forming substantially a lake covering the ditch and damming its outlet, so that the level at the lower end is the same as the upper end, the ditch is, of course, not functioning. If the ditch were laid out with a downward slope, you could hardly have a level shoot of water which would prevent its functioning as last suggested. Rec. *Id.* (3464).

RE-DIRECT EXAMINATION.

Where two streams cross each other at right angles, the effect on flow is this: If the streams have a very great velocity, one can obstruct the other materially. If

one has a shallow channel and crosses another with a deep channel, it often appears as though the tributary stream obstructed the deep stream because the drift and debris in the shallow stream flows across the surface of the deeper stream. If the velocities do not exceed more than two or four feet a second, the water in one stream could be stopped entirely, turn a right angle with a loss of head not exceeding from 1 to 2 inches. Rec. 2106 (3465), 2107 (*Id.*)

The fact the Bois de Sioux River was overflowed did not cause it to cease fuctioning. The velocity of the river would probably be greater than at a lower stage of water. The flood plane water would be flowing with small velocity. If the overflow were caused by damming or obstruction, the velocity of course would be lessened. Rec. 2107 (3465).

The river would function the same as usual except that the hydraulic gradient might be slightly less because below Fairmont the channel narrows. A five foot rise at the high bridge therefore was probably necessary to carry the water carried by a three foot rise in Lake Traverse. The hydraulic gradient would thus be reduced in the square root of those proportions. Rec. *Id.* (3466).

With reference to the suggestion that the overflow at the area of confluence was solely due to precipitation, it is my opinion that it was due to the combination of precipitation and the artificial conditions. The run-off coming originally from the precipitation is brought down more quickly by reason of the increased channel capacity. Rec. *Id.*

RE-CROSS EXAMINATION.

The lessening of the hydraulic gradient in the supposed case of the overflow of the Bois de Sioux would not cause the river to cease functioning but to function less effectively. Rec. 2108 (3467).

As to the claim the influx of waters from the Rabbit dams the flow of those in the Bois de Sioux, such a result could not happen unless the waters at the mouth of the Rabbit were raised to the same level as those at White Rock. The crest of a sudden flood coming down the Rabbit might cause some back water for a few hours. Rec. *Id.*

GEORGE A. RALPH: Since I was previously called in this case I have made further measurements on the

ground and caused complainant's Ex. 49 to be made from those measurements. Rec. 2108 (3468-69).

There has been considerable testimony to the effect that the original ditch and cut-off intersect 12 Mile Creek at substantially right angles. The conditions are accurately shown on the plat Ex. 49. Rec. 2109 (3469).

This diagram shows the bridge over 12 Mile Creek and a cross section at that point. The computed discharge there is also shown on the plat. Rec. *Id.*

I was on the ground during the flood stage in 1916 and observed the level of the waters as compared with the level of this bridge. The water was then approximately 1½ feet above the floor of the bridge. Rec. *Id.* (3470).

The diagram also shows the cross section of the cut-off at a point about 400 feet west of the confluence with 12 Mile Creek. I selected this point as the point of control from the circumstance that the indications showed the waters used the entire cross section at that point. Rec. 2110 (3470-71).

Professor Bass' statement that at the level of 1002 the velocity of flow in the ditch was 2.4 feet is incorrect. At that stage the minimum would be 4.4. At that stage and velocity the discharge capacity of the cut-off would be 1760 second feet. Rec. *Id.* (3471).

At the level of the waters as I observed them during the flood stage, the height would be 1004.5 and the capacity of the cut-off would be 2404 second feet. Rec. *Id.* (3472).

In computing capacity with the water at 1002.5, I took the velocity of 4.4 feet. At the higher elevation of 1004.5 I took the velocity at 4.77 feet for the reason that the velocity increases with the depth. Rec. 2111 (3472).

I began drainage work in 1888 and have been engaged in drainage and reclamation every since. I have constructed or had charge of the construction of over 300 different ditches in Minnesota. I have been employed as consulting engineer on drainage work in North and South Dakota, Iowa, Wisconsin, Canada, Kentucky and Missouri. I have had charge of the measurements of the various watersheds in Minnesota covering a period of nearly 40 years. I have prepared and published the only complete report of the discharge of streams in Minnesota. Rec. *Id.* (3473).

There are particular points in all channels, which,

from an engineering standpoint, are regarded as controlling in estimating channel capacity, for the reason that there are relatively few points where accurate measurements can be made. The point marked "B" was selected for this reason. Rec. *Id.* (3474).

There is nothing to the claim that has been so much emphasized in this case to the effect that a ditch which is overflowed will cease to function. The shallow surface waters flow much slower than the deep waters of ditches and other channels. The waters flowing in from the side even though they overflowed the ditch, would have little effect on its functioning, in fact, the velocity of the water in the ditch would increase with its depth. Rec. 2112 (3475).

There is nothing to the claim that has been emphasized in this case to the effect that the ditch construction did not follow the natural line of flow. The ditches generally are constructed on the line of greatest slope. From an engineering standpoint, the ditch construction in this area is properly laid out according to the best engineering principles. Rec. *Id.*

Ex. 49 shows a cross section of the Mustinka River at the Milwaukee bridge near Wheaton as it existed at the time in controversy. The water level, as I have plotted it, comes to a point within three inches of the top of the caps on the piling. Rec. *Id.* 2113.

The water channel at flood stage at this point had an area of 1050 square feet, and the discharge at the extreme flood stage was 4336½ second feet. I observed the level of the water with reference to the wagon bridge. It was over the floor of the bridge. Rec. 2113 (3476-77).

CROSS EXAMINATION.

I saw the level of the water on the bridge just north of the cut-off at flood stage in 1916 and afterwards measured its elevation by running levels from the fixed government bench mark on the wagon bridge about a quarter of a mile east of the bridge in question. That bench mark was made by the State Drainage Commission in 1913 and was verified from the government bench marks on which my surveys of this watershed have been based. These last are at White Rock: at a point about three miles southwest of Wheaton at Diamond at the Interstate bridge and other points. I ran these levels twice in 1917. Rec. 2113 (3477), 2114.

The point at which I determine the elevation of 1004½

feet is marked "A" on defendant's Ex. 4. From the point "A" as you proceed further west, there is considerable fall. Rec. 2115 (3480-81).

The fall from contour line 1005 over to contour line 997 takes place in a distance of about 2½ miles. Rec. 2117 (3484).

The old river channel was running full banks at the time mentioned in 1916. The overflow waters from the main channel would in part flow southwesterly back into the Mustinka irrespective of the ditch. Rec. *Id.*

In estimating the cut-off capacity, I took the cross section at the point "E" as 504 square feet. Rec. 2118 (3487).

I took the actual top width 56 feet, the depth 12 feet and the slope approximately 1 to 1: I didn't take the average top width or the average depth because neither was necessary. Rec. 2119 (3488).

If the average top width was only 43.83 feet, the cross section and hydraulic radius would not be smaller. My discharge measurements are based on fixed factors not affected by the cross section of other parts of the ditch. Rec. *Id.*

I took the top and bottom width and divided it into different sections to determine the accurate area of 504 square feet. I had a cross section of 30 feet wide and 11.6 feet deep, giving 348 square feet. I had a section 3 feet by 6.4 feet and one 7 by 9 feet. The former gave me 19.2 square feet and the latter 63 square feet. Other sections gave me 19.2 square feet and 54 square feet, making a total of 514.4, from which I deducted 8 square feet to allow for irregularities, with the result of a net area of 504 square feet. I took the average width of the top at about 42 feet. There were, of course, sections much wider and others narrower. I did not take an average depth as you cannot get an accurate measurement in that way. Rec. *Id.* (3489).

In my former examination, I did not consider the effect of the cut-off on the floods of 1915 as I did not know how effectively the ditch was operating in the spring of that year. The dredge was still in the channel. In 1917 I took the bottom elevation at 992.5. If the elevation was 995, the hydraulic radius would be reduced. Rec. 2120 (3490).

The complainant's Exhibit 1, the fall, beginning at the southern extremity of the Delta Zone, down to the point

just mentioned as "A", is north and slight west, from 1040 to 1005. At the confluence of Twelve Mile Creek and the Mustinka Channel it is 998. The courses of Twelve Mile Creek and Five Mile Creek are practically north. The artificial ditches shown by defendant's Exhibit 7 are invariably straight east and west. They are properly laid out down the greatest slope and almost at right angles to the contour lines. Rec. 2121 (3491).

Twelve and Five Mile Creeks run at right angles to the line of greatest slope; that is, if they continued, but they change their course to west and south. Rec. *Id.* (3492).

Referring to the testimony of local residents that in 1915 and 1916 a large volume of water flowed north through the flood channels north of the old Mustinka ditch and particularly in sections 13, 14, 15 and 16, Twp. 128, Range 45, I made observations respecting that flow. The water spread out in those years all over the Delta Zone for the reason the Mustinka was surcharged and the dike was built across the inlet to the Rabbit. Rec. *Id.*

I drove all over the Delta Zone in the summer of 1916 and 1917 and there was not anywhere near as much water as I had seen there in years before the ditches were put in. The local residents who have claimed that there was more water there in 1915, 1916 and 1917 are mistaken. The claim is entirely in conflict with their testimony before the legislative investigating committee and similarly in conflict with the recitals of the preamble of the legislative act appropriating money for the ditch. If you assume there was some water there in those three years, the fact might be ascribed to greater precipitation than at any previous periods. It would have to be much greater and that was not the case. Rec. 2122 (3493).

I think that the 8000 acres referred to in the preamble of the legislative act as flooded from 1898 and which had never been flooded before had been flooded in all wet seasons for all time prior to 1898 and that this recital is not correct. Rec. *Id.* (3494).

In Exhibit 1, I have included practically all of Clifton Township east of Twelve Mile Creek except the southern tier of sections in the Delta Zone. These lands were subject to overflow in times of high water but all of them were not swampy or marshy. Rec. 2123 (3495).

As to the recital in the preamble that one of the pur-

poses of the ditch's construction was to drain swampy lands, I do not think there was any large quantity of swamp lands when the ditch was constructed. Rec. *Id.* (3495).

The government plat of Clifton Township shows no swamp lands, but there is considerable low land there overflowed in times of high water. The government survey may have been made in seasons such as 1910 or '11 when the country was very dry. Rec. 2124 (3496).

The Delta Zone, as I have outlined it, extends over the northwestern portion of Logan Township in Grant County. The government survey does not show any swamp land. The same is true as to the lands included by me in the Delta Zone, which are in Gorton Township. Also, of Redpath Township, with the exception of what is known as Redpath Slough. I know of no lands in Clifton, Logan or Gorton Townships which were conveyed to the State. Rec. *Id.* (3497), 2125.

I was familiar with the testimony given before the legislative committee, and as I now recall it, it referred to land along the Mustinka, below the mouth of the old State ditch. Rec. 2125 (3499).

That is an area extending from the northerly part of the bend down to the Wheaton bridge. Rec. *Id.*

I was state Drainage Engineer from 1900 to 1913. I laid out the ditch in question but it was done against my best judgment and protest. In fact, I resigned rather than go any further with it. Rec. *Id.*

My plan was to make an impounding reservoir of Lake Traverse; correct the channel of the Mustinka as it has been corrected and to correct the channels of the Rabbit and Bois de Sioux, all of which could have been done for about one-fourth the damage that has been caused by damming the water into Lake Traverse. In my opinion, the construction of the original ditch in 1896 transferred part of the waters from the Delta Zone down to the area last mentioned. Rec. *Id.* (3500), 2126.

The extension was to provide an outlet for these waters and furnish a better outlet for the original ditch and drain the Delta Zone. In my opinion, the extension accomplished this purpose, transferring the flood plane lower down and causing the flooding of the Bois de Sioux Valley. Rec. *Id.* (3501).

Of the flooded lands in question, I would not think over 25% would be considered marsh lands. Rec. *Id.*

The area would be greatest at the south State line just north of White Rock and diminish gradually as you went north. Rec. 2127 (3502).

So far as the government surveys were concerned, the showing of swamp lands would depend largely upon whether the survey was made during a wet or dry season. Rec. *Id.* (3502-03).

The witness' attention was called to plats of government surveys of Townships 129 and 130, with reference to showing the marsh lands thereon disclosed, and stated that he assumed the surveys were approximately correct at the time they were made. Rec. 2128 (3504).

Exhibit 5, purporting to be the findings of the legislative committee, shown the witness. I could not say from my investigations that there was anything in this statement contrary to the facts. Rec. 2129 (3505).

The 8000 acres referred to are lands lying south and west of the river loop and then extending down toward Wheaton. The testimony with reference to damages referred to the same land. Rec. *Id.*

I have never stated that the lands last referred to were flooded before the construction of the ditch. The lands mentioned in my testimony were those flooded before the years 1895 and '96, and included in the area marked blue on complainant's Exhibit 1. Rec. *Id.* (3506).

The lands at the confluence of Five Mile and Twelve Mile Creeks with the Mustinka River were, in years past, overflowed during the west seasons and when the first section of the ditch was constructed more waters were brought down to the Delta Zone and the additional lands included in the 8000 acres below were also subject to floods. Rec. *Id.* (3507), 2130.

The differences between my statement of the elevation of the cut-off of 992.5 and Mr. Ringdahl's, to the effect that it was 995, have no bearing on the matters testified to by me. The sea level datum used in the ditch survey was obtained from the railroad company's elevations. It would have to be changed to accord with the datum used in the surveys of 1916. Rec. 2130 (3507).

The difference between the United States Geological Survey datum and that of the United States Army engineers arises from the fact that there was a considerable discrepancy between their records. At the point in question, this was adjusted by employing the standard sea

level datum. This adjustment was made in 1912 and I employed it in my surveys. Rec. *Id.* (3508).

The witness' attention was called to the evidence of Charles Tesky, Carl Krenz, Emanuel Hokinson and others, and was then asked, assuming the correctness of this testimony, to show how, in his opinion, the artificial conditions were contributing factors to or explained such floods and replied, that under the present conditions the flood waters would be carried down much more rapidly. Rec. 2131, 2132.

That the waters in the entire watershed would be collected and the flow much accelerated by the ditches and that a flood not perhaps as great as in former years might produce a greater volume of water at the junction between the Mustinka and Twelve Mile Creek for the reason the water would be carried there much more rapidly than in a state of nature and that part of their outlet in the natural state was shut off by the dike. Rec. 2132, (3512).

RE-DIRECT EXAMINATION.

The ditch construction shown on defendant's Exhibit 7 taps certain lakes near Herman. These ditches will carry the water to Five Mile Creek or into Twelve Mile Creek. All the water would go to the same place, that is, up there in this district where the cut-off ditch is and where Tesky's and the other farms are. Rec. 2133 (3513).

The witness' attention was called to the testimony of the witness Rogers, who lives in Sec. 22, Clifton Township, and who had explained how the water overflowed the ditch on his farm in 1916. Also the testimony of other witnesses of similar character, and said that Twelve Mile Creek carries a large amount of water that it would not carry in a state of nature by reason of the artificial construction near its headwaters. This applies to the Mustinka watershed. The lakes east of Herman did not discharge their water in Twelve Mile Creek or Five Mile Creek in a state of nature except in a roundabout way and then only to a limited extent. Rec. 2134 (3515).

I did not mean by my answer to Mr. Palmer's question that the lands in North Dakota bordering the Bois de Sioux could not be cultivated or were not cultivated. Rec. *Id.* (3516).

I meant it was better suited for meadow and could not

be used successfully, year after year, for raising crops. The land along the Bois de Sioux is of quite solid character. In ordinary seasons you can drive along the river without difficulty but there is a strip subject to overflow at ordinary high water. Rec. *id.*

RE-CROSS EXAMINATION.

By the dike I refer to the embankment on the north side of the ditch. Rec. 2135 (3517).

This is some three feet above the surface of the ground and operates as a dike as there are no openings to permit the escape of water except a small culvert near the corners of Sections 1, 6, 7 and 12. The ditch is shown on Exhibit 7 as County Ditch No. 10 and was formed from throwing the elevated dirt out on the north side. This was afterwards leveled to make a roadway. Rec. *Id.*

The natural point of overflow into the Rabbit River is at the corner of Sections 1, 6, 7 and 12, Twp. 128, Ranges 45 and 46. In a state of nature the waters also overflowed at a point about three-quarters of a mile east of that just described. Rec. *Id.*

As to the testimony of overflow at a point about three-quarters of a mile west on the west side of Section 1 and of there being a flood channel there, I examined the river bank very carefuly at that point. There is no flood channel. The river bank is solid and of uniform height from Tesky's farm on the west and the water would have to reach a stage over 998 before overflowing that bank. When it reaches 996.5 or above that, it will overflow to the north into the Rabbit Rive. Rec. 2132 (3518).

As to the testimony of the witnesses who claimed they saw water flowing north from the river west of Tesky's in 1916, the water was very high in that year and the river was overflowing its bank for two or more miles south and west of Tesky's place. I have no doubt it overflowed some to the north and west but there is no channel. It is a level surface and there is no erosion. Rec. *Id.* (3519).

This might also have been the fact in 1917. The water is brought down so rapidly that a flood might accumulate at the junction of Twelve Mile Creek and the Mustinka and overflow. It would accumulate there in much larger volume than in a state of nature. Rec. *Id.*

I ascribe the flood in the Bois de Sioux Valley in 1916,

to some extent, to the dike along County Ditch No. 10. Rec. 2137 (*Id.*)

These county ditches all collect the flood waters and carry them into the Mustinka state ditch much faster than they would be carried in a state of nature and the waters are carried to Lake Traverse and discharged there in much larger volume and shorter time than in a state of nature. These ditches contribute quite substantially to that. Rec. 2137 (3520).

The difference between the flood conditions along Five Mile Creek, before and after the artificial construction, is that in former years before the artificial construction, the floods would remain much longer. Under present conditions, the flood waters should run off in a week or ten days at most. Rec. 2138 (3521-22).

The witness' attention was called to the fact that in 1916 the flood waters destroyed the crops in Clifton Township, and replied, I worked over that land and ran levels in Redpath and Clifton Townships and there was very little, if any, of the land that I could not walk over, dry shod, in low shoes in June, 1916. There may have been crop failures for the reason they couldn't get the crops in or there may have been a flood after the crops were in which destroyed them. What I say is, that the floods under present conditions are carried off rapidly, where formerly they used to remain two or three months. Rec. *Id.*

As to the 132 farms referred to from the tax records, there should be about 40 farms in that Delta Zone. I think you will find that the 132 farms are on the border of the zone or occupy what might be called the high spot, but there are large areas in that zone which have never been cultivated that are in a wild state today notwithstanding the fact the lands have been partly settled in that locality for more than forty years. Rec. *Id.* (3523).

I know that part of the lands referred to here lie partly without the Delta Zone and that they might be cultivated. In dry seasons, such as 1910 and '11, the whole zone might be cultivated. The testimony given here might be substantially correct and yet make no difference in my opinion. Given an area which would include 400 farms of 160 acres, you might find a quarter of those tracts which could be cultivated in the ordinary year. But, at the same time, there is a large area that was over-

flowed there in a state of nature within which aquatic grasses grow. That condition does not exist since the ditches were recently put in. I believe that they can cultivate more of that area than they are actually cultivating, but there is a considerable part that is not cultivated. Rec. 2136 (3524).

RE-DIRECT EXAMINATION.

The local ditches would not have materially contributed to the floods in the Bois de Sioux Valley if the main State ditch had not been constructed. Rec. 2140 (3526).

The surcharge of Five Mile Creek and Twelve Mile Creek results in backing the water up in the ditches, making them more liable to overflow. Rec. *Id.*

The discharge records at Wheaton for the month of July, 1916, showing a total 25,446 second feet; for August, 3,357 second feet; for September. 1,322 second feet; for October 959 second feet, and for November, 783 second feet, shows that the June rains in the Mustinka watershed had been carried off rapidly and discharged in large volumes down the Mustinka River in a short period of time. Rec. *Id.* (3526-27).

The low rate of run-off in the following months indicates the watershed was well drained in a short period instead of being gradually drained, as it would be in a state of nature. Rec. 2141 (3527).

The discharge of 3357 second feet in August would show that there was no flooded condition in the Delta Zone. Rec. *Id.* (3528).

At this point, complainant offered certified statements of the County Auditor of Richland County, N. D., also, legislative findings of the Committee of the House, p. 1272 of the House Journal of 1909; motion in the House for the Committee to hear the petition of settlers, p. 577 of the House Journal of 1909; appointment of Committee to hear petition, p. 672 House Journal 1909; Conference Committee report House Journal, p. 1371, and the proceedings House Journal April 8th, 1909, p. 1512; Senate Journal, p. 1411, April 22nd, 1909; Senate Journal, 1909, p. 1411, April 21 1909. (3407).